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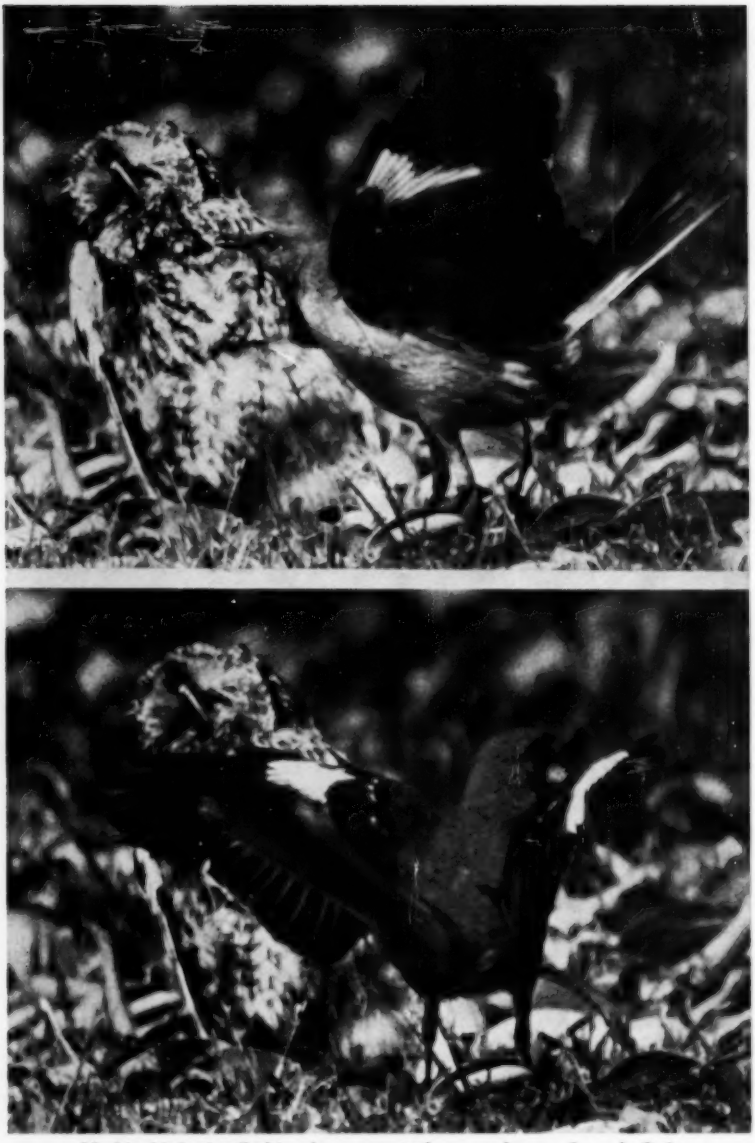

Mockingbird wing-flashing between attacks on a dummy Screech Owl.

ON THE FUNCTIONS OF WING-FLASHING IN MOCKINGBIRDS

BY ROBERT K. SELANDER AND D. K. HUNTER

In recent years, several notes in this journal have called attention to the distinctive wing-flashing of the Mockingbird (*Mimus polyglottos*), in which the wings are opened upward at about 45° in a series of jerking movements, then closed. In this display, large white wing patches are exposed. The function of this behavior remains unknown; but, since the display is most frequently seen being performed by birds that are foraging on the ground, it has been suggested (Gander, 1931; Allen, 1947) that exposure of the contrastingly patterned wings facilitates food-getting by startling the more active insect types and illuminating the more sluggish types in dark areas on the ground. This interpretation has been questioned, however, by Sutton (1946) and Halle (1948), who noted that wing-flashing also occurs in the Calandria Mockingbird (*Mimus saturninus*), and by Haverschmidt's (1953) and Whitaker's (1957) observations on *M. gilvus*, species which lack white patches in the wings.

An understanding of the functional significance of this behavior will be achieved only when we have more complete information on the behavioral contexts in which it appears. Therefore, the following notes on its use in agonistic situations may be of some value.

Observations

On April 17, 1960, we watched a pair of Mockingbirds mob a Screech Owl (*Otus asio*) that was perched in an oak tree on the campus of the University of Texas, Austin. Observations began at 3:40 p.m., when our attention was attracted by the familiar "predator call" of the Mockingbirds, a rasping *chew* sound introduced with an accented note and having a sharply descending inflection. Nasal *chew* notes of constant pitch were also being given. In the oak tree, the Mockingbirds were moving excitedly around the owl at distances from one to three feet, with the body plumage compressed, the tail widely fanned, and the folded wings held slightly out from the body, apparently in readiness for flight. The fanned tail was repeatedly flicked upward, and calling was almost continuous. Occasionally one of the birds made a rapid pass at the owl. Periodically one or the other Mockingbird gave a typical wing-flash; and, in a ten-minute period, we recorded 16 wing-flashes. Significantly perhaps, most wing-flashes were given when the birds were backing away from the owl and none was given by a bird about to attack. Some wing-flashes seemed to be directed to the owl, others were perhaps given to the other Mockingbird, and some seemed to be undirected. As in Mockingbirds displaying while foraging, the wing-flashes of the mob-

bing birds varied in intensity; in some the wings were only partly opened, while at the other extreme they were all but fully spread. The mobbing continued for an hour as we watched; but, since the owl soon shifted to a new position high in the tree, we were unable to follow closely the activities of the Mockingbirds.

On April 20, 1960, we were able to elicit mobbing attacks on a dummy Screech Owl and to photograph the display (Front.). In three tests, each lasting 15 minutes, the dummy was placed within the territories of three pairs of birds. In the first test, eight wing-flashes were noted as the birds mobbed the owl, which was placed on a traffic sign six feet above the ground; in the second, response was weak and intermittent, and only three wing-flashes were recorded. In the third test, with the dummy on the ground, one bird, probably the male of the pair, gave a total of 105 wing-flashes, and its mate gave four. The male (?) wing-flashed many times on the ground between flying attacks on the dummy and also wing-flashed on a wire 8 feet above the dummy and in a nearby bush. On the ground, wing-flashes were given at distances varying from a few inches to several feet from the dummy. Many were given as the Mockingbirds faced the back and sides of the owl, and some were given as they faced away from the dummy. We wish to emphasize the fact that the wing movements of these birds were identical with those of birds wing-flashing while foraging.

Mr. Thomas R. Hellier has kindly supplied notes on the behavior of a Mockingbird near Ottawa, Kansas, in the summer of 1956. On three occasions in a 15- to 20-minute period, he saw a Mockingbird fly from a tree to the ground and wing-flash several times in succession as it walked toward a domestic cat that was resting on the ground at the base of the tree. The bird approached the cat from behind and from the side and flew up to the tree as the cat became alert and turned to face it. Apparently wing-flashing may be used as Mockingbirds are reacting to a variety of predators, for Hicks (1955) reports wing-flashing by a bird attacking a blacksnake.

Mockingbirds also wing-flash in agonistic encounters with individuals of their own species at territorial boundaries and within such boundaries. And they may be induced to display by setting out a dummy Mockingbird within their territories. In May, 1956, Selander performed several experiments of this type in connection with a demonstration of territoriality for an ornithology class. The following excerpts from his notes are typical. Sex determinations were based on relative body size, males being larger than females.

May 1.—A male dummy in horizontal posture was placed on a lawn chair within the territory of a pair of Mockingbirds attending recently-fledged young. One bird gave loud *chew* notes, then both birds came to the chair with the "heavy" flight characteristic of birds defending territory. One (the male?) gave wing-flash display, fanning the tail at the same time; he then flew at the dummy, striking it with bill and feet. Both birds

wing-flashed several times, then the male (?) again attacked. At this point the episode was interrupted and the dummy removed.

May 4.—A wingless dummy in resting posture on a T-post was set out within the territory of a pair of Mockingbirds that was feeding a young fledgling. Both birds approached the dummy and wing-flashed several times. One bird flew to a perch above the dummy and gave a low-intensity wing-flash. The other then flew to the ground and wing-flashed strongly several times. Meanwhile, the first bird returned to the T-post and wing-flashed once. It then flew up and away but turned back and made a passing attack on the dummy, following which it flew to the ground, where both birds wing-flashed many times, perhaps directing their displays to each other. To this point, both birds had been silent, but now one, probably the female, began to give *chew* notes. The male (?) soon began calling and made another attack on the dummy, hitting it with bill and claws. Then he rejoined the female (?) on the ground and the two birds displayed strongly several times as they faced one another. This episode ended as both Mockingbirds flew away.

May 6.—A dummy with wings wired in wing-flash position was set out on the ground. The male (?) came to the dummy and displayed before it, walked around in back, and struck it six times from behind. Meanwhile, the female (?) came to the edge of bushes 10 feet away and wing-flashed. Later, when the male (?) had left the dummy, the female (?) came to the ground, calling repeatedly, gave a weak display, walked around the dummy giving increasingly more intense versions of the display, and finally gave a full display before walking away.

Discussion

Whatever the biological significance of wing-flashing in Mockingbirds may be, the behavior appears early in development and is almost undoubtedly innate, for we have seen it in nestlings and it has previously been observed in young fledglings (Allen, 1947; Sutton, 1946).

The fact that the wing-flashing occurs while Mockingbirds are mobbing an owl, are reacting agonistically to dummy Mockingbirds placed in their territories, or are disputing territory with live Mockingbirds at territorial boundaries and elsewhere is open to several interpretations. If we assume that wing-flashing is not a typical social display—that is, that it has no function in communication among members of the species—but, rather, functions only in foraging, its occurrence in agonistic contexts could be attributed to "displacement" (Tinbergen, 1952), as suggested by Brackbill (1951). And since mobbing or fighting Mockingbirds clearly show ambivalence of tendencies to attack and to flee, it is perhaps not surprising to find irrelevant or "displacement" activities appearing. In owl-mobbing behavior, which does not differ greatly if at all from the behavior of birds reacting to Mockingbird dummies, the folded wings are held out slightly from the body in preparation for flight, and chance movements of the bird or flight-intention flicks of the wings may result in "transitional actions" (Lind, 1959) leading to "displacement" wing-flashing.

A second hypothesis is that wing-flashing is genuine agonistic display

serving a threat function. If this is the case, the apparent mutual display of paired Mockingbirds confronted with a dummy might be interpreted as redirected aggressive behavior. Following this line of argument, the fact that Mockingbirds commonly wing-flash while foraging, sometimes in the apparent absence of other Mockingbirds, could be explained if the display also serves as a method of territorial advertisement, calling attention to the presence and position of the territory owner when it is not actively standing guard or patrolling its territory.

All evidence considered, we are inclined to think that Sutton's suggestion (1946) that wing-flashing is primarily a "gesture indicating wariness, suspicion, [and] distrust" is more nearly correct than any other. We suggest that wing-flashing in the Mockingbird represents a highly ritualized flight-intention movement of the wings, which, evolving originally as a social signal or wariness, has acquired a secondary function in food-getting. It is possible that it may also function to intimidate other birds in addition to indicating an apprehensive "mood." This theory would account for its frequent use by birds that are mobbing an owl or are reacting to the presence of a live or dummy Mockingbird in their territory. We further suggest as a working hypothesis that the Mockingbird's use of the display while foraging may be individually conditioned. Perhaps when first foraging on the ground, the young Mockingbird is apprehensive and gives the display; insects are flushed as a result, and in time the bird comes to associate wing-flashing with foraging, reinforcement being provided by the capture and eating of insects.

The hypothesis that we are advocating, and which is actually an extension of that proposed by Sutton, has the advantage of accounting for the appearance of the display in such different contexts as foraging and mobbing. It also eliminates the necessity of invoking "displacement" as a causal factor, which is perhaps desirable considering the difficulties involved in distinguishing between "displacement activity" and nondisplacement behavior (Hinde, 1959:593).

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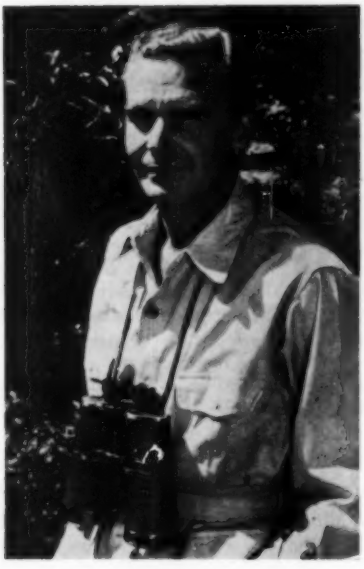
DEPARTMENT OF ZOOLOGY, THE UNIVERSITY OF TEXAS, AUSTIN, TEXAS, APRIL 20, 1960

NEW LIFE MEMBER



Paul A. Schwartz, of Caracas, Venezuela, a new Life Member of the Wilson Ornithological Society, has been an active member of the Society since 1952. A mechanical engineer by profession, Mr. Schwartz is a contributor to the serious literature of ornithology. He has published a life history of the Rusty-breasted Ant Pitta (*Grallaricula ferrugineipectus*), and some two dozen of his excellent color photographs of birds may be seen in Gilliard's "Living Birds of the World." Some of his extensive field notes on South American birds were used for text material in that book also.

In addition to life history studies and photography, Mr. Schwartz is interested in nesting studies, migration, and sound recording. He is also a member of the A. O. U., Cooper Ornithological Society, Laboratory of Ornithology of Cornell University, Sociedad Venezolana de Ciencias Naturales, Sociedad de Ciencias Naturales La Salle, and the Hawk Mountain Sanctuary Association.

A FIELD STUDY OF THE MOCKINGBIRD'S WING-FLASHING BEHAVIOR AND ITS ASSOCIATION WITH FORAGING

BY JACK P. HAILMAN

THE peculiar "wing-flashing" behavior of the Mockingbird (*Mimus polyglottos*) has been the subject of much study and discussion among American field workers, and yet there is little agreement on the biological function of this behavior. The most prevalent theory, perhaps, is that the motions are associated with hunting insects (e.g., Gander, 1931; Hebard, 1949*a*, 1949*b*; Wampole, 1949; Brackbill, 1951). However, Sutton (1946) believed that wing-flashing is an alarm reaction, because several observers reported it when birds were confronted with strange objects or situations (e.g., Michener and Michener, 1935:106; Laskey, *in* Sutton, 1946; and Sutton, 1946). Recently Brackbill (pers. comm.) has come to believe that the behavior is produced by hostile or fear motivation. Others have termed wing-flashing a sexual display (Forbush, 1929:320), and one observer (Tomkins, 1950) concluded that "it has no present value to the species."

Disagreement concerning the form of the behavior as well as its function has arisen. Sutton's (1946) painting shows a Mockingbird with its wings held high above its back, but Wampole (1949) describes the wings as being moved horizontally. Many authors do not describe the motions they call "wing-flashing."

METHODS

Field observations were made from June to August, 1958, at eight localities in the suburbs of Washington, D.C., and from April to July, 1959, in Norfolk, Virginia. The 1959 study was of adults only, since it was terminated before general fledging time, and involved only about three pairs of birds; the 1958 observations were of both young and adults.

For statistical purposes, each individual Wing-flash is assumed to be an independent observation. This assumption seems valid, because each Wing-flash is usually spaced from the next by a definite time interval, even when no other motions intervene.

Standard statistical methods are used. Probability of a proportion in a sample was determined by either the exact binomial or the normal approximation, as noted. Comparisons of proportions from two samples are made with the proportions test outlined by Wallis and Roberts (1956:429), utilizing the Yates correction for an uppertail probability; this is valid because the direction of the alternative hypothesis was anticipated. Throughout, probabilities of below .01 are taken as significant, those from 01 to .05 as bordering significance, those of .05 to .10 as possibly indicative of difference, and those above .10 as insignificant.

Since the 1959 birds were drawn from a different statistical population than were the 1958 birds (different in geography, time of study, time of year, and age composition), data from the two populations are compared only with qualification. It is also possible that any systematic errors by the

observer (say, in recording the number of hitches/Wing-flash) were different in 1958 and 1959. Only the corresponding segment of 1958 population is compared to 1959.

Acknowledgments

I am indebted to Mrs. Lovie Whitaker and Dr. George M. Sutton for comments on the manuscript. I am especially grateful to Dr. Robert K. Selander for sharing his ideas about Wing-flashing and supplying me with several photographs comparing Wing-flashing in different behavioral situations. See Dr. Selander's paper (Selander and Hunter, 1960) for another view on the function(s) of "wing-flashing."

Form of Wing-flashing

The term "wing-flashing" is fairly descriptive of the Mockingbird's behavior, and has been so frequently used in the literature that a change in terminology here could not be justified. Nevertheless, the term has been used to designate a variety of unrelated motions (see discussion in Hailman, 1959), so that some distinction is necessary. For the remainder of this paper, the capitalized term "Wing-flash(ing)" refers to the specific behavior pattern of the Mockingbird described below; the term "wing-flashing" refers to behavior previously described in the literature which cannot definitely be assigned as true Wing-flashing, and as a general term for discussing similar wing motions of other species.

Wing-flashing of the Mockingbird takes place as follows: the bird stands on the ground with body held in normal position (spinal column at an angle of about 35° with the ground), and with its head forward, begins the wing motions. Sometimes birds tilt the head slightly to the side or down in front, but most birds look nearly straight ahead. The wings are opened simultaneously in a series of distinct motions, or "hitches." The number of hitches is variable in a given individual, and is usually one to three, occasionally four or five. The direction in which the wings open is also variable, which may account for some of the disagreements in the literature. Sometimes the wings seem to be opened nearly vertically above the bird; at other times nearly horizontally, the latter occurring especially when the bird is running while Wing-flashing (which is rare). When the number of hitches is few, the direction is not evident.

When the wings are hitched open, the white patches appear to "flash," hence the original term. (However, quite similar "wing-flashing" occurs in other species of the Mimidae which have no wing patches. See Whitaker, 1957, and wing-flashing in other species, below). Once the wings have been extended, they are brought back to the body in one smooth, quick and direct motion. This closure concludes the Wing-flash proper, and behavior which follows is variable.

Two principal hypotheses were investigated: that Wing-flashing is a social or sexual display, and that Wing-flashing is a foraging motion. If Wing-flashing displays the white patches as a signal to other birds, it seems reasonable that (a) the presence of other birds would elicit Wing-flashing, (b) Wing-flashing would usually be performed only when other birds are present, and (c) the performance would affect in some way the behavior of birds present, especially other Mockingbirds. It was quickly evident from field study that none of these conditions existed. Finding no other evidence that Wing-flashing serves a communicative function, I turned to the second possibility.

It was necessary to find how the Mockingbird forages, and then whether or not foraging and Wing-flashing were associated, and if they were, what the nature of the association was. Feeding of adults on the ground during spring and summer in general resembles the behavior of Robins (*Turdus migratorius*), running over bare areas, stopping and occasionally striking. Ground foraging of the Mockingbird may be divided into three principal patterns: (1) look down into the grass (to spy prey?); (2) run or hop a few inches, presumably when no prey is seen in the immediate area; and (3) strike. The association of these three motions with Wing-flashing was investigated in detail.

Wing-flashing and Foraging on the Ground.—If, as suggested by several previous observers, Wing-flashing startles insects or other prey into betraying themselves, it would be expected that Mockingbirds would often strike just after Wing-flashing. Therefore, quantitative data were gathered on the number of times Mockingbirds struck after Wing-flashing, the number of times they did not, and what the birds did if they did not strike. The data are arranged in columns corresponding to the category of behavior following the Wing-flashing (Tables 1–5). These data were also divided into rows according to the number of hitches in each Wing-flash.

The 1958 results (Table 1) show an extremely high association (about 96 per cent) of Wing-flashing followed by one of the motions of foraging (80 versus three non-foraging occurrences). The probability of a difference this great or greater by chance alone is significantly small to be discounted ($P = < .0001$ by exact binomial). In this sample about one Wing-flash in five was followed by strike at prey, and about half of these strikes were seen to produce captures.

I noticed in the 1958 study that a bias was introduced into my field data because often after Wing-flashing a bird ran or looked down, and then struck. Because I took no systematic notes on this "second" motion after Wing-flashing, these sequences are not reflected as strikes in Table 1. There-

TABLE 1

WING-FLASHING BY ADULTS ON THE GROUND IN 1958

Wing hitches	Behavior following Wing-flash			
	hop/run	look	strike (capture)	other
1	7	6	2 (2)	2[1]
2	15[2]	12	6 (3)	0
3	8	13	6 (2)	1[3]
4	1	2	0	0
5	1	1	0	0
Total	32	34	14 (7)	3

[1] One bird flashed immediately after strike, but gave no reaction after Wing-flash. Other bird gave no reaction.
[2] One bird ran, gave the "predator warning call" (Hailman, in prep.), and stopped foraging.
[3] Bird appeared to be frightened while Wing-flashing and flew away quickly.

fore, in re-evaluating the behavior with the Norfolk Mockingbirds in 1959, I created two new categories: "hop/run–strike" and "look–strike."

Table 2 also shows that the association of Wing-flashing with foraging motions (about 99 per cent) in 1959 is highly significant (256 of 258 observations; probability of chance difference: $P = < .0001$ by exact binomial). In fact, a test on the proportions shows that the 1959 birds' Wing-flashes may have been more closely associated with foraging than were the 1958 Wing-flashes ($P = .087$). In 1959, well over two-thirds of the Wing-flashes were followed by actual strikes, either immediately or with a short run or look-down intervening. This number is far above that expected by chance (191 strikes versus 67 nonstrikes is highly significant at $P = < .0001$ by the normal approximation to the binomial) and is significantly greater than strike occurrence by the 1958 birds ($P = < .001$ by proportions test). Strike success was not recorded in 1959.

It is interesting to note the details of "non-foraging" Wing-flashes (notes to Tables 1 and 2). The observations suggest that when Wing-flashing was not followed directly by foraging behavior, some other motivating factor was present, such as frightening stimulus, presence of young birds, etc., which conflicted with foraging. The bird (Table 1) which Wing-flashed after striking may have been stimulated by some sort of "surplus" motivation; in any case, the observation is generally within the context of foraging.

Furthermore, the average intensities (as measured by the number of hitches/Wing-flash) of the behavior pattern seem to be higher when associated with foraging than when not. In Table 1, the mean intensity of "foraging" Wing-flashes is 2.30 hitches, whereas the mean intensity of "non-foraging" Wing-flashes is 1.67. In Table 2, the mean foraging intensity is 2.46 and the mean nonforaging intensity is 1.00. The few nonforaging

TABLE 2

WING-FLASHING BY ADULTS ON THE GROUND IN 1959

Wing hitches	Behavior following Wing-flash					
	hop/run	look	hop/run–strike	look–strike	strike	other
1	10	12	4	0	45	2[1]
2	9	8	1	0	41	0
3	4	6	4	4	45	0
4	6	9	5	2	40	0
5	1	0	0	0	0	0
Total	30	35	14	6	171	2

[1] One bird gave no action; other bird looked at young Mockingbird nearby.

observations in each case preclude a meaningful statistical comparison, but the consistent large differences are indicative of lower intensity in nonforaging situations.

The Wing-flashing of Mockingbirds on the ground is used as a standard by which to compare Wing-flashing in other instances recorded in 1958. Due to the variables already discussed, it is not appropriate to use the 1959 data for exact statistical comparisons. However, the 1959 data (Table 2), if anything, show a closer connection between Wing-flashing and foraging (especially striking) than do the 1958 data (Table 1), and a mean intensity of the same order.

Wing-flashing Aloft.—A few times Mockingbirds were seen to Wing-flash while perched on fences, bushes, trees, and other places above the ground; these observations are summarized in Table 3. During the 1958 study period, Wing-flashing aloft accounted for about 10 per cent (%2) of all adult Wing-flashing seen (Tables 1 and 3). Aloft, eight Wing-flashes were definitely associated with foraging on the ground, while the other was followed by a strike and capture aloft. The connection of Wing-flashing and foraging is thus 100 per cent (%, highly significant at $P = < .002$ by exact binomial), although this perfect correlation in a small sample does not indicate a greater connection of Wing-flashing and foraging while aloft than on the ground. (Proportion test with Table 1 shows $P = .098$, which does not indicate a significant difference.)

Again, taking hitches as a measure of intensity, it is possible to compare the intensities of Wing-flashes aloft with those on the ground. The 3-hitch level was the highest given by aloft birds, which suggests that motivation is less than on the ground. Calculating the mean intensity of Table 3 (foraging) Wing-flashes reveals a mean of 1.78, compared to a mean of 2.30 of foraging intensities of Table 1, also suggesting a difference.

TABLE 3

WING-FLASHING BY ADULTS PERCHED ALOFT IN 1958

Wing hitches	Behavior following Wing-flash				
	look at ground[1]	fly to ground	fly to ground and strike[2]	strike aloft[2]	other
1	2	0	0	1 (1)?	0
2	3	1	1 (1)?	0	0
3	0	1	0	0	0
Total	5	2	1 (1)	1 (1)	0

[1] All birds perched at heights less than 6 feet.
[2] Numbers in parentheses indicate captures, as in Table 1.

WING-FLASHING BY FLEDGED YOUNG

During the 1958 study period, 41 Wing-flashes by about seven fledged young Mockingbirds still in the "dependency period" were observed (Tables 4 and 5), 32 of which were performed on the ground. The "dependency period" is tentatively defined as that time after which young animals have left the nest, but during which time they are dependent upon at least one parent for food and/or protection (Hailman, 1960*a*), and seems to be an important time in the development of behavior.

Considering only the Wing-flashes on the ground (Table 4), 21 of 32 Wing-flashes were followed by one of the three motions of ground foraging (probability of chance difference by normal approximation $P = .056$, which borders significance). If the "begging" were included as a category of foraging, the proportions would be considerably larger; this treatment is considered below. Considering the "beg" column as "non-foraging" observations, the percentage of foraging Wing-flashes is considerably lower in fledged young than in adults (about 63 per cent versus 96 per cent). A proportion

TABLE 4

WING-FLASHING BY FLEDGED YOUNG ON GROUND IN 1958

Wing hitches	Behavior following Wing-flash				
	hop/run	look	strike (capture)	beg[1]	other
1	3	4[2]	4 (0)	1	4
2	0	2	2 (0)	0	1
3	1	0	3[3] (2)	4	1
4	0	2	0	0	0
Total	4	8	9 (2)	5	6

[1] All birds gave species begging call.
[2] One bird gave begging call.
[3] Two birds gave begging call.

test on the raw data shows this difference to be highly significant ($P = < .001$).

Furthermore, the Wing-flashes of fledged young seem to produce a lower strike success and have a lower average intensity. Strike success was only two out of nine, but is not significantly lower than that of the 1958 adults (Table 1), which was seven out of 14 ($P = .175$ by proportions test). Perhaps the small samples obscure a difference. The mean intensity of fledged young foraging Wing-flashes is 1.86, and is lower than the mean intensity for adults (2.30 of Table 1). Further, the mean intensity for the "beg" column in Table 4 is higher (2.60), and that of the "other" column lower (1.50), than the foraging intensity, although the small samples preclude meaningful statistical comparison.

Finally, there are several other considerations of Table 4 to be noted. First, the young showed a new behavior, "begging," following Wing-flashing, and this category accounts for about 12 per cent (5/41) of the observations. Second, the "other" behavior is not readily attributable to conflicting drives or distractions, as were those of adults. That is, when a young bird did not forage or beg after Wing-flashing, it simply did nothing noticeable. The Wing-flashing appeared to be largely undirected and irrelevant. Last, several foraging observations in Table 4 were accompanied by the screech-like "begging-call" of the species, the same as is given while the young are actually begging (notes to Table 4).

If, as suggested above, the begging observations are considered to be part of "foraging" behavior, the proportion of "foraging" Wing-flashes (26 of 32) becomes highly significant ($P = < .001$ by the normal approximation). This also makes proportions of "foraging" behavior similar to that of adults —although still not as high (about 81 per cent versus 96 per cent) and statistical tests on the raw data show the differences to be insignificant ($P = .165$ approximately, by proportions test). Including begging also raises the mean intensity of the young's foraging Wing-flashes to 2.00 which is similar to the 2.30 mean of adults. Thus the parameters of Wing-flashing by fledged young on the ground resemble those of Wing-flashing by adults, when the former group includes "begging" as a foraging response.

A few observations were made of fledged young Wing-flashing while perched aloft (Table 5). These constitute 18 per cent (5/30) of the observations of fledged young, whereas aloft Wing-flashes were only about 10 per cent of the adult total. Probably the begging-calls of the young aloft more often called my attention to their Wing-flashing than did any factor of the adults' behavior aloft. All the Wing-flashes of young birds aloft were followed by begging (5/5, $P = < .002$ by exact binomial).

TABLE 5

WING-FLASHING BY FLEDGED YOUNG PERCHED ALOFT IN 1958

Wing hitches	Behavior following Wing-flash	
	beg[1]	other
1	9	0

[1] All birds gave begging-call. Adult bird within 5 feet of young in every case.

DISCUSSION

To state that Wing-flashing is definitely used in foraging is the conclusion of this paper but not the end of the problem. The exact mechanism by which Wing-flashing is utilized is still in doubt, for instance, and how the behavior develops is still unknown.

An inference from this study is that Wing-flashing frightens insects into betraying themselves (see Hailman, 1960*b*, for other evidence), and therefore increases foraging efficiency of the Mockingbird. But even if this were true, does Wing-flashing flush insects by casting a shadow over them, or by reflecting light upon them, or by some other mechanism? Allen (1947) suggested the white under-wings reflected light into the grass; if so, does this actually frighten insects, or does it just enable the bird to see them better? I am continuing observations on this problem.

My observations on young birds show that the actual motor pattern of Wing-flashing is developed at fledging, but that "proper" (adult) use of it is not. That is, young birds give Wing-flashing irrelevantly without association with foraging motions, or while begging. Many previous observers have noted that young birds tend to Wing-flash when confronted with strange objects or in strange situations (Michener and Michener, 1935:106; Laskey, *in* Sutton, 1946; Sutton, 1946; J. R. Michener, Laskey, and Brackbill, all in pers. comm.). The connection of Wing-flashing and begging (also mentioned by Sutton, 1946) suggests that internal hunger stimuli may contribute to the motivation of this behavior in young birds. These facts suggest that young birds capable of performing the motions early in life learn how to use them later, perhaps when insects jump or twitch before them.

The phylogenetic origin of the wing motions is unknown. Sutton (1946) believed Wing-flashing to be a modification (ontogenetic or phylogenetic?) of the wing-fluttering of begging young. In my experience the motions are quite dissimilar, the latter being a loose vibratory motion of the wings while they are held slightly out from the side in contrast to the hitching upward of Wing-flashing; I never saw any intermediate motions. Wing-twitching motions of the Starling (*Sturnus vulgaris*), which are analogously associated

with insect capture, closely resemble wing-flicks of flight intention (Hailman, 1959), but no such similarity exists in the Mockingbird. Although the Mockingbird's behavioral repertoire includes many other wing movements (such as courtship flights, "wing-flickering," Spread-display, etc.), none resembles Wing-flashing closely enough to suggest common origin.

Previous Reports of Wing-flashing

The many previous reports of Wing-flashing in the literature have generated a number of hypotheses and disagreements about the behavior. The variation in actual form of Wing-flashing should now be settled (above, and Wampole, 1949; Tomkins, 1950; Brackbill, 1951). Many authors have concluded from their observations that the function of Wing-flashing is foraging; others who have not stated this conclusion, nevertheless have included information in their reports which indicates that it is true (e.g., Michener and Michener, 1935:106, 111, 118; Sutton, 1946; Sprunt, *in* Bent, 1948:307–308; Tomkins, 1950; Whitaker, 1957). Only two references I have seen do not mention foraging: Forbush's (1929:320) early account casually refers to this behavior as "courtship," and Hicks (1955) called a predator reaction "wing-flashing," although the actual form of the behavior observed is not described.

Recently, Selander and Hunter (1960) have shown that Mockingbirds use a Wing-flashing-like behavior when mobbing owls or dummies, and possibly in intraspecific hostile encounters. I suggested to Selander that this pattern might be different from, but very similar to, true Wing-flashing. However, he has seen the motions in the foraging context described here, and is "convinced that the wing motions do not differ" (pers. comm.).

Nevertheless, I believe that many of the conclusions in the papers which assign a function other than foraging to Wing-flashing can be explained by four factors: (1) observations were of young birds, in which the foraging connection is not yet made; (2) behavior observed was not Wing-flashing, but may have been one of the other numerous wing motions of the Mockingbird (male wing-droop display, vertical and swoop song-flights, female precopulatory wing-quivering posture, young begging posture, etc.); (3) the entire behavioral situation was not observed (*i.e.*, there were other motivating factors present, such as young, which distracted the Mockingbird's attention from feeding); and (4) single observations may have been of the rare cases in which Wing-flashing is not connected directly with foraging (see Tables 1–3).

Wing-flashing in Other Species

In Mimidae.—Several other species of the family Mimidae use apparently homologous motions. Halle (1948) observed Wing-flashing in the Calandria

Mockingbird (*Mimus saturninus*), as well as in *polyglottos*, and noted that the former was "doing the same thing in the same way" as the latter. Another member of the genus, the Graceful Mockingbird (*M. gilvus*), Wing-flashed while foraging (Haverschmidt, 1953), using apparently similar movements; in fact, it is a quite common habit of this species (Haverschmidt, pers. comm.). Whitaker (1957:361) also observed this species giving the "same jerky movements used by *polyglottos*" while foraging. Neither *saturninus* nor *gilvus* has wing patches. Laskey (*in* Sutton, 1946:208) "observed an adult Brown Thrasher (*Toxostoma rufum*) opening and closing its wings while investigating something . . . where it had been hunting food." Tomkins (1950) also reports having seen this species ". . . flash its wings in identical fashion" to the common Mockingbird. Thomas (Whitaker, 1957) has apparently observed Wing-flashing by the Brown Thrasher many times.

Wing motions of the Blue Mockingbird (*Melanotis hypoleucus*), seen by Skutch (Whitaker, 1957:362), and of the Catbird (*Dumetella carolinensis*), mentioned by Vaurie (1957:309–310), may bear some relation to true Wing-flashing, but no good description of their physical form is yet available, and they do not appear to occur in a foraging context (at least from preliminary descriptions), as do the Wing-flashing motions of the species mentioned above.

In non-Mimidae.—It is obvious that merely because motions are termed "wing-flashing" it does not make them either homologous or analogous to Wing-flashing of the Mockingbird; such behavior has previously been discussed and cited (Whitaker, 1957; Hailman, 1959). However, many species of non-mimids do possess analogous wing-movements which are used in foraging, apparently to flush prey. Sutton (1946) mentioned such motions of the Roadrunner (*Geococcyx californianus*) and the Least Bittern (*Ixobrychus exilis*). Whitaker (1957) cited accounts of wing movements in foraging African herons. To these could be added the Starling's (*Sturnus vulgaris*) "wing-twitching" used in insect capture (Hailman, 1959) and two kinds of wing movements by the Louisiana Heron (*Hydranassa tricolor*) during foraging (Hailman, 1960c). I think it is significant that of the Galapagos finches, only the insect-eating "*Certhidea* repeatedly flicks the wings partly open when hopping about the bushes," while the seed- and fruit-eating forms do not do this (Lack, 1947:146).

Conclusions

From my own observations and from the reports of others, the following conclusions about Wing-flashing may be formulated: (1) In adults, it is definitely a foraging motion, but it is possibly also used in predator displays; (2) In young birds the connection with foraging is not as great; factors of hunger, fear and curiosity seem instrumental in eliciting the behavior. The

major problems concerning Wing-flashing now seem to be: (a) exactly how is the behavior used in foraging; (b) what is the exact role of Wing-flashing in inter- and intraspecific hostile situations; and (c) how does the behavior develop?

Summary

The Mockingbird (*Mimus polyglottos*) lifts its wings in jerky motions termed Wing-flashing. The number of "hitches" in which the wings are spread varies between one and five, and the direction of spread varies from nearly horizontal to nearly vertical. Wing-flashing is not used as a display to other birds. The behavior following 83 Wing-flashes of adults on the ground in 1958 consisted of one of three foraging motions: running, looking down, and striking, except for three observations. Likewise, 1959 data showed 256 of 258 Wing-flashes followed by foraging. All of the nine Wing-flashes given aloft were followed by foraging.

Fledged young on the ground followed Wing-flashing by 21 foraging motions and five begging postures; six Wing-flashes were given irrelevantly. Aloft, all of the nine were followed by begging.

Previous reports on functions of Wing-flashing differ in conclusions, but upon re-examination all indicate that foraging was probably the principal factor involved; probable causes of other conclusions are discussed. Apparently homologous motions are used in other Mimidae species for foraging, and many unrelated species use various forms of wing motions in foraging.

In adults, then, Wing-flashing is used in foraging, possibly to flush insects; but in young birds it is often given irrelevantly, and seems to be motivated by hunger and curiosity.

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4401 GLADWYNE DRIVE, BETHESDA, MARYLAND, JULY 5, 1960

MIGRATION OF THE SANDHILL CRANE EAST OF THE MISSISSIPPI RIVER

BY LAWRENCE H. WALKINSHAW

OVER a period of years I have assembled many records of the Sandhill Crane (*Grus canadensis*) from North America. The two subspecies (*G. c. canadensis* and *G. c. tabida*) generally seem to follow three different migration routes. Some cranes wander from these main routes but few migrate east of a line from James Bay to eastern Georgia. Many migration records exist from Wisconsin, Michigan, northeastern Illinois, Indiana, western Ohio, eastern Tennessee, and in recent years from Georgia, and some apparently from northern Florida, indicating a definite migration route from northwest to southeast in fall and vice versa in spring. Apparently there are few records from Alabama and Mississippi except for the resident Florida Sandhill Cranes (*G. c. pratensis*) in the far south. Some cranes are observed migrating across Minnesota, a few in western Iowa and Missouri, but none across Arkansas and Louisiana.

The central migration route seems to extend from Mexican wintering grounds, Texas, and New Mexico, northward east of the Rockies, but mainly through the western parts of Oklahoma, Kansas and Nebraska, and through South and North Dakota into Saskatchewan and Manitoba. It also extends across the eastern parts of Colorado, Wyoming, Montana, and Alberta. Apparently there is a division of this route north of the United States, some flocks going into Manitoba northward while others cross western Saskatchewan and eastern Alberta northward to Alaska and Yukon Territory, even in some cases to northeastern Siberia. Some cranes migrate from Alaska along the Pacific states and British Columbia to southern California, probably also to Baja California, Sonora, and western Chihuahua. The migration route from Alaska to northeastern Siberia crosses the Bering Straits but some cranes appearing on Bering Sea islands suggest a possible long flight at times across water.

Since it is impracticable to use complete data for all three main migration routes in one paper, I have tried to amass the chief data from east of the Mississippi (Fig. 1), hoping to do similarly later with each of the other two routes. The large number of sight records of the Sandhill Crane from Indiana (where the species has not bred for 30 years) and several from eastern Tennessee, central Kentucky, and north and central Georgia show the direction of flight.

We do not know whether cranes fly continuously from northern Indiana and southern Michigan to their wintering grounds or whether they stop in isolated spots for night roosting. They might stop only when weather conditions become unfavorable. It does seem as though cranes would be observed

FIG. 1. Map of Sandhill Crane migration east of the Mississippi River. ●—breeding records; ○—areas where cranes have been observed outside normal breeding areas.

on the ground more often if they did stop for the night. Only occasionally are they seen on the ground.

Southern Michigan and northern Indiana are about 900–950 air-miles from the Okefenokee Swamp. Cranes fly about 32 to 35 miles per hour, so it would require 25 to 30 hours of flying time to make the journey, providing all flying conditions were favorable.

Small fall concentrations now occur in Michigan (at times 150 cranes) in both the Upper and Lower Peninsula breeding areas. There has been a gradual increase in recent years in these numbers. Larger concentrations sometimes occur in central Wisconsin (as many as 600) and much larger concentrations at Jasper-Pulaski Game Preserve in northern Indiana. Here cranes have steadily increased during recent migrations so that nearly 2000 gather in spring and in fall at one time. No one knows from where these birds have come nor where they are going. No one knows how long they remain, whether some come early, stay a few days and then move on, being replaced by other groups, or whether some birds remain for many weeks. Possibly some of these cranes may migrate much farther north than central Wisconsin and northern Michigan. Some may go into northwestern Ontario where cranes have been found in summer in recent years.

Concentrations of cranes have occurred in central Florida in both winter and summer on the Kissimmee Prairie. In other Florida areas only a few cranes have been found in winter. An average of six Christmas bird counts per year were made in Florida from 1934 through 1945, yet none listed any Sandhill Cranes. Eleven areas have listed the species between 1946 and 1958, in addition to the Okefenokee Swamp in southern Georgia. During 1957, nine of 23 areas listed a total of 107 cranes in Florida and 190 from the Okefenokee Swamp.

Allan Cruickshank (letter, January 5, 1959) commented on a winter increase of cranes in Florida each year. He wrote:

> Whereas no intensive careful survey has been made of Sandhill Cranes in our section of Brevard County, it is very obvious to anyone who does much field work that there is a definite increase during the winter months. The species is represented locally by only a few pairs from mid-March until late October. During the winter small groups, occasionally scores, are found. Our Christmas counts for the last four years are: 1955, 81; 1956, 64; 1957, 55; 1958, 32. On the 1955 count, H. Bennett and I counted 77 in one plowed field. On the other hand, during March, April, May (I am away in June, July, August), September and October, I have covered our best crane territory during a full day and observed from none to three pairs.
>
> The decrease on Christmas counts does not reflect a decrease of the species, but a decrease in the plowing operations on a large ranch within our Christmas count circle.

Dale W. Rice, having considerable interest in the Sandhill Crane from work he had done in Indiana and Texas, spent three springs at the University

of Florida at Gainesville, from February, 1953 to June, 1955 and did considerable work in the field during that time. In a letter from Rice (January 12, 1959) he gave the following information:

Sandhill Cranes are permanent residents on Payne's Prairie, six miles south of Gainesville. This is the "Alachua Savanna" of William Bartram, who found cranes there about 1775. On the basis of several field trips to this area, total populations of resident cranes were as follows: 1953 before nesting, 9 cranes; after nesting, 14 cranes. 1954 before nesting, 13 cranes; after nesting, 19 cranes. I know of no other place in the Gainesville area where cranes breed. It is possible that there are small resident populations elsewhere on the prairies of north Florida.

The following records include all my observations on cranes other than those that were without doubt resident Florida Sandhill Cranes. I believe that they were all migrating Greater Sandhill Cranes, because of (1) the size of the flocks, (2) the season of occurrence, and (3) behavior. The large flocks on Payne's Prairie were always seen out on the open grassland, and never in the sloughs occupied by the resident birds.

Spring 1953

13 March—at 1145, I saw three cranes flying high overhead, heading northwest, over the University of Florida Campus.

14 March—Between 1030 and 1050, I saw 41 cranes (three flocks of 6, 12, 23 birds respectively) circling overhead. They seemed to be circling and not going anywhere in particular.

(15 March—I went to Payne's Prairie hoping to find the flocks seen on the 14th, but saw only one pair of cranes.)

Autumn 1953

7 November—At 1400, I saw 46 cranes (two flocks of 42 and 4) feeding on the open grassland of Payne's Prairie.

14 November—At 0800, 9 cranes were seen on Payne's Prairie, and at 1300, a flock of 42. (On 19 November, I found only 4.)

Spring 1954

11 March—Dr. Archie Carr saw a flock of 13 flying over the campus. I saw a flock of 4 over the campus.

12 March—Edward L. Mockford saw a flock of 13 over the campus and the same the next day.

17 March—I observed a flock of 15 cranes flying over Hogtown Prairie, three miles west of Gainesville. (On 21 March, I saw only two cranes on Payne's Prairie.)

I had no observations for autumn, 1954.

Spring 1955

10 March—Between 1000 and 1030, three separate flocks of cranes, containing 9, 19, and 5 (total 33 birds), respectively, passed high over the campus heading NNW.

The cranes that were flying over and apparently "going somewhere" in spring were pointed directly toward Indiana. Dr. Claude Adams, and Mr. Thomas Hicks, at that time both graduate students in ornithology at the University, and both long time residents of Florida, told me that they had seen what they thought were migrating flocks of cranes quite regularly in the spring and/or fall.

Since the great Okefenokee Swamp has become a National Refuge, *G. c. pratensis* has nested there regularly in fairly large numbers at times. However, there are times when concentrations in winter occur there also. This could also be a stopping place during migration.

Cypert (1957) reported an increase in cranes in the Okefenokee Swamp during the 1956–1957 winter. The area, he wrote, consists of 330,000 acres of the swamp's 400,000 acres. During the winters of 1954–1955 and 1955–1956 the population was estimated at 200 cranes; during 1956–1957, 1000 cranes. On an all-day hike, January 29, 1957, 522 cranes were recorded on the Chesser Prairie; flocks were present on all the prairies in lesser numbers. After the middle of March, no large numbers were observed. He wrote: "Several factors may have contributed to this apparent decline (after mid-March) in population: (1) some of the birds evidently migrated to nesting grounds elsewhere; (2) there was a rise in water levels, a fact which might have made the swamp less attractive to cranes and caused part of them to leave; and (3) during the nesting season cranes are more scattered and are less likely to be seen."

Even the deeper water of spring, 1957, however, would not compare with that when I studied the cranes there during late March and April, 1945, when we navigated Chesser Prairie in a duck boat because the water was too deep to wade. Cranes nested then in goodly numbers.

Apparently there has been no increase in numbers of wintering cranes in Jackson County, Mississippi, and only two cranes have been reported at any season from southern Louisiana in recent years. During the winter of 1950–1951, two cranes remained at the Sabine National Wildlife Refuge (Lowery, 1955). Near Elberta, Baldwin County, Alabama, flocks of six and four were found between December 1, 1957 and March 20, 1958, and in early February, 1958, a flock of 12 (Newman, 1958*a*). However, two cranes also remained here into June, 1958, near Romar Beach, indicating a breeding group (Newman, 1958*b*). Other cranes observed in recent years in southeastern Alabama and in western Florida, all of which could have been migrants, are: A flock of 6, Prattville, Alabama, September 24, 1932 (Imhof, MSS); a flock of 14, 27 miles west of Pensacola, Florida, in southern Alabama, November 30, 1947 (Weston, 1948); 94, near Fruitville, Florida, November 27, 1955 (Stevenson, 1956); 3, 20 miles northeast of Pensacola, November 25, 1956 (Newman, 1957).

G. c. pratensis nests through much of Florida, Jackson County, Mississippi, probably Baldwin County, Alabama, and the Okefenokee Swamp of southern Georgia.

The following are some of the more important records of the Sandhill

Crane east of the Mississippi River and north of Florida and southern Georgia during the migration season.

GEORGIA

SPRING MIGRATION

Charlton Co., Chesser Is. March (*ca.* 1916), 100 in flight; March 19, 1933, 19; March 20, 1940, 200 flying high overhead in a northwesterly direction (Walkinshaw, 1953); winter, 1956–1957, large numbers (522 on January 29), disappeared by mid-March (Cypert, 1957).

Bibb Co., Macon. March 20, 1955, 6 in V-formation flying northward at 400 feet, 13 one hour later in late afternoon (Johnston, 1956).

Jones Co., Piedmont National Wildlife Refuge, Round Oak. March 6, 1952, 60 in a flock flying northward (Chamberlain and Chamberlain, 1952); March 11, 14, 15, 1957, 4 flocks flying north (some 525 to 550 cranes) (Chamberlain, 1957).

Jasper Co., Jackson Lake. March 24, 1940, 40 flying in long irregular wedge at 150 feet (Wharton, 1940).

Augusta region. May, 1894, 2 (Burleigh, 1958:212).

Fulton Co., Atlanta. March 7, 1953 (10 a.m.), 2 flocks—80 and 35, each in rough V-formation flying north, some calling (Peters, 1953).

Dawson Co., Dawsonville. March 23, 1958, 34 (Kahl, 1958).

Habersham Co., Clarkesville. April 24, 1944, 3 flying over; April 24–25, 1955, 1 cripple (Chamberlain, 1955).

FALL MIGRATION

Fulton Co., northern portion. Nov. 1, 1951, 3 (2 of which were shot but not saved) (Peters, 1952).

Forsyth Co., Lake Lanier. Nov. 10, 1957, about 35 flying southeast in V-formation at about 600–700 feet (Chamberlain, 1958).

Jones Co., Piedmont National Wildlife Refuge. Nov. 1, 1942, 15 flying silently southward in V-formation at 600 feet (Fleetwood, 1942); Oct. 31, 1949 (9:30 a.m.), 15 flying south at 200 feet (Ambrosen, 1950); Oct. 24, 1957, 20 flying over (Chamberlain, 1958).

Irwin Co., Osierfield. Nov. 18, 1959, 62 flying SSE at 400 ft. (Hopkins, 1959).

Chatham Co., Savannah. Oct. 19, 1956, 5 flying over city (Tomkins, 1956).

Ware Co., Waycross. Oct. 29, 1957, 19 flying over (Chamberlain, 1958).

Charlton and Camden counties, Coleraine. Oct. 27, 1945, and Nov. 27, 1947, cranes flying south (Hebard, 1953).

Camden Co., Kingsland. Dec. 20, 1950 until Jan. 20, 1951, 2 apparently wintered (Witter, 1956).

SOUTH CAROLINA

Georgetown Co., Hasty Point Plantation. Nov. 23, 1928, 1 (Metcalf, 1929).

North Santee River, Rice Hope Plantation. Dec. 19, 1941, specimen of *G. c. tabida* identified by H. C. Oberholser (Sprunt and Chamberlain, 1949:191).

Eston Co., Mt. Pleasant. Oct. 18, 1890, specimen of *G. c. canadensis* taken (Sprunt and Chamberlain, *ibid.*).

NORTH CAROLINA

Robeson Co., Lennon's Marsh. Nov. 21, 1957, 2 specimens of *G. c. tabida* (N. Carolina State Museum) (T. Burleigh, letter).

TENNESSEE

SPRING MIGRATION

Chattanooga. June 1, 1935, specimen taken (Butts, 1936).

Cumberland Co., Crab Orchard. March 13, 1939 (7:30 a.m.), 13 on ground, frightened and flew to north (Adams, 1939).

Anderson Co., Oak Ridge National Laboratory. Feb. 25, 1950, 4 flying over and calling (Howell, 1952).

Knox Co., Knoxville. March 25, 1954, 4 flying over, calling (Brooks, 1954).

Shelby Co., Memphis. Feb. 1, 1953, 2 flying into field, then rose and headed northward (Barbig, 1953).

FALL MIGRATION

Bedford Co., Shelbyville. Aug., 1936, specimen taken from flock of 4 (Edney, 1940).

Anderson Co., Norris Lake, Sequoia Pt. Oct. 21, 1951, 4 calling and circling overhead (Howell, 1952).

Union Co., near Hurricane. Nov. 10, 1956, 4 calling and flying over (Brooks, 1957).

Sevier Co., Seymour. Oct. 22–24, 1942, 50 present on wheat field for 3 days—one was shot (Ijams, 1942).

Shelby–Tipton county line, Third Chickasaw Bluff, Twelve Outlets. Nov. 30, 1820, large flock (Deaderick, 1940).

KENTUCKY

SPRING MIGRATION

Eubank. March 8, 1894 (Bent, 1926:251).

Jefferson Co., Louisville, Goose Is. March 19, 1933, 13 in flight (Carpenter, 1933); April 3, 1938, 1 present from March 31 to April 6 (Monroe, 1938); March 19, 1950, 9 flying in V-formation, then in single line northward (H. B. Lovell in letter).

Edmonson Co., Mammoth Cave area. March 30, 1958 (4 p.m.), 5 flying over (Dilley, 1958).

FALL MIGRATION

Jefferson Co., Louisville. Nov. 8, 1956, 11 flying in southerly direction (Stamm, 1957).

WEST VIRGINIA

Mason Co., Point Pleasant. Sept., 1934, 1 taken (Brooks, 1944).

PENNSYLVANIA

Waynesburg, Wayne Twp., Tom or Hoover's Run. Spring 1900 or 1901, 1 specimen taken; May, 1902, 1 (Todd, 1940).

NEW JERSEY

Cape May Co., Light House Pond. Oct. 6, 1958, 2 (Choate, 1959).

MASSACHUSETTS

Barnstable Co., Orleans, North Beach. Sept. 1, 1955, 1; Barnstable. Until mid-October, 1955, 1—probably same bird (Morgan and Emery, 1956).

OHIO

SPRING MIGRATION

Clermont Co., 18 miles east of Cincinnati. May 9, 1948, 1 (Spencer, 1948).

Montgomery Co., Spring Valley. March 22, 1959, 4 (Edith C. Blincoe, *Journal Herald* Staff Writer, Dayton).

Huron Co., Plymouth. April 1, 1911 (Todd, 1911).

Sandusky Co., 5 miles northeast of Fremont. May 14, 1937, 16 (Dr. and Mrs. T. H. Langlois); May 18, 1937, 3 (L. E. Hicks in letter). Two miles east of mouth of bay. March 23, 1939 (Hicks, *ibid.*).

Ottawa Co. March 18, 1954, 10 (H. Mayfield in letter).

Lucas Co., Grand Rapids, along Maumee River. March 29, 1941, 2 (Mayfield, *ibid.*).

Ashtabula Co., Pymatuning Reservoir, Ohio side. March 20, 1937, 1; March 25, 1938, 1 (L. E. Hicks in letter).

Alliance, March 23, 1886 (Bent, 1926:251).

FALL MIGRATION

Lucas Co., Sylvania. Oct. 23, 1949 (2 p.m.), 28 flying south in single file, not very high and calling (R. Whiting in letter).

Ashtabula Co., Ashtabula. Nov., 1949, 3 (Mayfield, 1950).

Mercer Co., southside Grand Reservoir. Nov. 26, 1943, 7 (L. E. Hicks in letter). Lake St. Marys. Oct. 14, 1945, 1 (Clark, 1946).

Fairfield Co., Buckeye Lake. Oct. 9, 1926, 5 flying (Trautman, 1940).

In addition to the above, Bent (1926:252) gave Ohio dates from Chardon (Geauga Co.), Nov. 7, 1888; Medina (Medina Co.), Nov. 8, 1920; Canton (Stark Co.), Nov. 5, 1911.

INDIANA

(See Fig. 2)

SPRING MIGRATION

Ripley Co., Versailles State Park. Week of March 18–25, 1945, 2 seen and heard (R. E. Mumford in letter).

Knox Co., Bicknell. March 18, 1906 (Cooke, 1914).

Owen Co. March 16, 1956, 1 (Keller, 1958).

Putnam Co., Greencastle. March 9, 1952 (9:50 a.m.), 18 flying due north on warm day; wind south, 10–12 mph (Cope and Snow, 1952) (Mumford, letter).

Marion Co., southern part. March 25, 1956, 1 (Keller, 1958). Indianapolis. March 19, 1953 (1 p.m.), 3 flying northwest (Nolan, 1953). Oaklandon Reservoir. March 2, 1946, 4 (Rice, 1946); March 16, 1946, 6 flying north (Rice in letter).

Hancock Co., Greenfield. April 21–28, 1952, 1 injured (J. D. McCall in letter to Mumford).

Wayne Co., Richmond. March 31, 1956, 2 (J. B. Cope in letter).

Delaware Co., Muncie. April 9 (period from 1923 to 1931) (H. Zimmerman in letter to Mumford).

Tippecanoe Co. March 25, 1950, 3 flying (Marks and Wright, 1950).

Benton Co., Oterbein, 8 miles north. March 14, 1959, 2 flying north at 150 yds. at 1:20 p.m., and flock of 22 at 300–400 yds. at 3:20 p.m. (R. E. Mumford in letter).

Carroll Co. April 7, 1885 (Evermann, 1888).

Fulton Co., Rochester. March 4, 1891 (Bent, 1926).

Kosciusko Co., North Webster. April 21, 1958, 2 flying ENE at 11 a.m. (J. D. McCall in Pittman–Robertson Report). Small groups of two to four have been reported over Kosciusko or Noble counties in the springs of 1955, 1956, and 1958.

Noble Co., Diamond Lake. March 14, 1955, 4; March 27, 1956, 3 in flight (R. Thomas in Indiana Pittman–Robertson Report).

Jasper–Pulaski counties, Jasper–Pulaski Game Preserve. April 10, 1935, 24; April 7, 1939, 40 and 200; spring, 1941, 150 (spring peak 300) (Gorrell, 1941); March 17 to April 16, 1942, peak of 350 (Waggener, 1943); March 10, 1943, first crane of the year;

FIG. 2. Recent migration records of the Sandhill Crane in Indiana.
(Map copyrighted by Rand McNally & Co., Chicago)

March 11, 6; March 21–30, 350; May 28, 1—the last crane; March 18, 1944, 100; April 8, peak 695, June 8, the last crane (Walkinshaw, 1949:122); Feb. 26, 1945, 2—the first cranes of the year; March 25–31, 500; April 25, 7—last cranes (Mumford, 1950); March 20, 1946, 350; March 24, 406; April 7, 23—last cranes (Mumford, *ibid.*); March 11,

1947, first cranes; March 16, 39; March 30, 180; April 12–13, 190; last on May 2 (Mumford, *ibid.*); March 27, 1948, 200; March 28, 582 (Walkinshaw, 1950*b*); April 10, 17 (Mumford, *loc. cit.*); March 3, 1949, 6; April 2, 641; April 13, 11 (Mumford, *ibid.*); March 4, 1950, 7; March 25, 548; April 1, 628; May 2, 7; June 15, 2 stayed all summer (Mumford, *ibid.*) Feb. 25, 1951, 43; March 30, 331; March 31, 588; April 4, 63; April 20, 75 (Mumford in letter); Feb. 3, 1952, 1; Feb. 22, 1; March 8, 6 (Mumford, *ibid.*); March 29, 862; April 7, 300; March 28, 1953, 1019; March 29, 1164 (Grow, 1954), and 1214; Feb. 21, 1954, 3 (R. Grow in letter); March 19, 900; April 8, 80 (R. Mumford in letter); April 6, 1955, 144; March 23, 1956, 1560; March 24, 1716; Feb. 24, 1957, 27; March 30, 1524; April 10, 140 (Mumford, *ibid.*); March 27, 1958, 273; March 29, 1375; March 30, 345.

Newton Co., Willow Slough Game Preserve. March 20, 1951, 18; March 24, 1951, 7; March 29, 1951, 29; March 15, 1952, 18; March 22, 1952, 28; March 29, 1952, 12; April 5, 1952, 12; March 13, 1955, 1; Feb. 28, 1956, 5; March 31, 1957, 4 (Burr, 1957); March 18 and 23, 1958 (D. N. Martin in Indiana Pittman–Robertson Report); March 12, 1959 (Madden, verbal).

Marshall Co., Lake Maxinkuckee. April 6, 1885 (Evermann, 1920).

Lake Co., Crown Pt. April 2, 1949, 105 in flight (R. E. Phillips in letter to Mumford).

Porter Co. March 14 to April 20, 1957, 4 records (Burr, 1957); April 5, 1958, 1 (Burr, 1959). Baileytown. April 2, 1945, flocks of 14, 17, and 11 (Lewy, 1945); March 30 to April 22, 1951, 8 flocks—8–60 cranes (Mayfield, 1951*b*); April 1, 1955, 1 (R. Grow in letter).

Indiana Dunes. April 16, 1920, 1 (Sanborn, 1922); April 7, 1917, 3 (H. L. Stoddard in notes to Mumford); April 5, 1942, 5 (Smith, 1942); April 12, 1942, 57 (Smith, *ibid.*); March 31, 1949, 2 (D. H. Boyd in letter to Mumford); April 2, 1949 (Boyd, *ibid.*); April 2, 1950 (Boyd, *ibid.*).

LaPorte Co. March 21, 1953, 5 (M. Sweet in letter to Mumford); April 5, 1958, 44 (Burr, 1959).

Steuben Co., Pokagon State Park. April 9, 1943, 3 flying north.

FALL MIGRATION

Newton Co., Willow Slough Game Preserve. Sept. 20, 1951, 2; Sept. 22, 1952, 3; Oct. 7, 1954, 18; Sept. 18, 1956, 10; Oct. 3, 1956, 51 (Mumford in letter).

Jasper–Pulaski counties, Jasper–Pulaski Game Preserve. Oct. 15, 1941, 50; Nov. 1, 72; Nov. 27, 36; Sept. 17, 1942, 2; Oct. 20–27, 120–135; Nov. 12, 87; Nov. 13, 27; Nov. 25, 23 (Walkinshaw, 1949:112); Oct. 5, 1943, 12; Oct. 23, 160; Oct. 28, 143; Oct. 29, 66; Nov. 12, 9; Oct. 9, 1944, 2; Oct. 10–14, 13; Oct. 15–21, 56; Oct. 22–28, 127; Nov. 5–11, 128; Nov. 12–18, 135; Nov. 26 to Dec. 2, 39 (Mumford, 1950); Oct. 15, 1945, 66; Oct. 17, 90; Oct. 21, 250; Oct. 23, 150; Nov. 8, 65; Nov. 30, 8 (Mumford, *ibid.*); Sept. 30, 1946, 15; Oct. 27, 210 (Mumford, *ibid.*); Oct. 19, 1947, 106 (Mumford, *ibid.*); Oct. 4–10, 1948, 100; Oct. 11–17, 330; Oct. 18–31, 400; Oct. 17, 232; Dec. 15, 4—the last (Mumford, *ibid.*); Sept. 24, 1949, 3; Sept. 25, 7; Sept. 27, 15; Sept. 28, 39; Oct. 21, 190; Oct. 23, 623; Nov. 5–6, 500; Dec. 13, 17; Dec. 15, 1—last bird, had a broken leg (Mumford, *ibid.*); Sept. 13, 1950, 3; Sept. 14, 11; Sept. 27, 54; Oct. 5, 169; Oct. 10, 188; Oct. 17, 205; Oct. 24, 219; Oct. 25, 266; Oct. 27, 328; Oct. 29, 370; Oct. 31, 392; Nov. 3, 429; Nov. 6, 728; Nov. 12, 17, and 27, 811; Nov. 30, 706; Dec. 5, 622; Dec. 8, 310; Dec. 11, 122; Dec. 13–14, 5—the last (Mumford in letter); Oct. 7, 1951, 18; Oct. 14, 250; Oct. 15, 178; Oct. 20, 400; Oct. 28, 500; Nov. 4, 405; Nov. 11, 593; Nov. 24, 350; Dec. 1, 83; Dec. 5 and 8, 25; Oct. 14, 1952, 100; Oct. 27, 1192; Nov. 8, 393; Nov. 9, 317; Oct. 31, 1953, 600; Nov. 1, 1040; Dec. 8, 200; Sept. 22, 1954, 22; Oct., 150 plus; Oct. 23, 304 (Burr, 1955); Oct. 30, 1500 estimated; Oct. 31, 750

plus; Oct. 3, 1955, 75 (D. Martin in Indiana Pittman–Robertson Report); Oct. 18, 275 (D. Martin, *ibid.*); Nov. 12, 850 estimated; Nov. 1, 1958, 1500 estimated; Nov. 2, 1767; Nov. 26, 16.

Pulaski Co., Tippecanoe State Park. Oct. 17–24, 1943, 3 (Mumford in letter).

DeKalb Co., Waterloo. Sept. 7, 1904 (Bent, 1926).

Tippecanoe Co. Oct. 20, 1956, 3 (Burr, 1957). Lafayette. Nov. 18, 1949, 5 (Mayfield, 1950).

Delaware Co., Muncie. Oct. 25, 1955, 7 (Satter, 1956).

Marion Co., Indianapolis. Oct. 26, 1944, specimen; Nov. 24, 1950, 135 flying south at 400 feet in large wedge-shaped flock at 1 p.m. and calling (Rice, 1951). Oaklandon Reservoir. Nov. 7, 1948, one or two flocks heard very high, flying south—unable to see birds (Rice, 1949); Oct. 26, 1950, 32—probable—observed by farmer in cornfield.

Morgan Co., Mooresville. Nov. 24, 1957 (between 11 a.m. and noon), groups of 25, 8, 13, and 16 flew over, and one flock heard only (West, 1957).

Morgan–Monroe counties, Morgan–Monroe State Forest. Nov. 4, 1953, 30 flying south at 2:15 p.m. (Mumford in letter).

Knox Co., Bicknell. Oct. 27, 1894 (Cooke, 1914:13).

Vanderburgh Co., Diamond Is. Nov. 3, 1820 (Perkins, 1936).

ILLINOIS

(See Fig. 3)

SPRING MIGRATION

Wabash Co., Mt. Carmel. March 1, 1863, March 4, 1868 (Cooke, 1914:12).

Marion Co., Odin. Feb. 19, 1890 (Black, MS).

Fayette Co., Vandalia. April 10, 1894 (Black, MS).

Scott Co., Griggsville. March 24, 1884 (Bent, 1926).

Champaign Co., Rantoul. April 17, 1909, March 28, 1914, April 2, 1916 (Black, MS).

Iroquois Co., NE of Beaverville. March 29, 1952, 10 (Walkinshaw, Wing).

Whiteside Co., Tampico. March 8, 1887 (March 25—six-year average) (Cooke, *loc. cit.*).

DeKalb Co., Genoa. April 19, 1953 (Smith and Parmalee, 1955).

Cook Co., Orland. March 23, 1920 (Black, MS). Orland Wildlife Refuge, McGinnis Slough. April 8, 1940. Blue Is. March 31, 1940, 23 (Bartel, 1940). Willow Springs. March 27, 1954, 31 flying NW and calling (Mrs. W. T. Lory in letter). Hinsdale. May 20, 1923 (Black, MS). Chicago region. April 17, 1877 (Black, MS); April 7, 22, 1917, April 22, 1920, April 3, 1928 (Ford *et al.*, 1934; Black, MS); April 28, 1934, March 25, 1948, March 20, 30, 1949 (Ford, 1956).

Lake Co., Waukegan. April 3, 1939 (Boulton and Pitelka, 1939).

Florida (Illinois). March 19, 1888 (Bent, 1926).

FALL MIGRATION

Lake Co., Lake Forest. Aug. 22, 1877 (Black, MS). Barrington, Bakers Lake. Oct. 11, 1958, 35 flying. Lake Bluff. Nov. 7, 1948 (Smith and Parmalee, 1955).

Cook Co., Chicago region. Sept. 16–17, 1929, Sept. 4, 1932, Oct. 24, 1947, Aug. 28, 1949 (Ford, 1956).

Will Co., Crete. Sept. 11, 1915 (Eifrig, 1919).

Bureau Co., Bureau. Oct. 27, 1906 (specimen, U.S. Nat. Mus., 200 965).

Mason Co., Havana. Oct., 1951, 1 (S. C. Kendeigh, letter).

Champaign Co., Rantoul. Oct. 29, 1917 (Black, MS). Urbana. Nov. 13, 1954, 1 wounded (Smith and Parmalee, 1955).

FIG. 3. Recent migration records of the Sandhill Crane in Illinois.

Schuyler Co., 10 mi. north of Beardstown. Nov. 3, 1946, 4 (T. E. Mussellman in letter).

Randolph Co., Sparta. Sept. 5, 1950, 1 (Mayfield, 1951*a*).

Williamson Co., Crab Orchard Wildlife Refuge. Nov. 7, 1952 (Smith and Parmalee, 1955). Crab Orchard Lake. Oct. 7, 1954 (Smith and Parmalee, 1955).

ONTARIO

Below is a summary of records of the Sandhill Crane from Ontario.

1772: Mouth of Severn River. Forster (1772) indicated that the species nested here.
1862: Kent Co. Two adults with 2 young (McIllwraith, 1894).
1869: Rondeau. Specimen collected by J. Oxford (Nat. Mus. Canada).
1872: Toronto. A pair was collected in the fall by G. Warren (Roy. Ont. Mus. Zool.).
1881: Kent Co. Two observed, one collected (Allin, 1943).
1882: Mitchell Bay, St. Claire Flats. A pair observed (Allin, 1943).
1890: Leeds Co., Mud Creek. A pair shot (J. Thompson). Escott. Flock flying over (Toner *et al.*, 1942).
1892: Thunder Bay Dist., Silver Is. One shot from flock of 5 on Sept. 27 (Allin, 1943).
1893: Mt. Forest. Reported in April (Allin, 1943).
1935: Gore Bay. Mounted specimen, said to have been taken several years earlier (Williams, 1942).
1939: Ft. Williams, 50 mi. SW. Sept. 30, 4 flying over (Allin, 1943).
1941: Port Arthur, 30 mi. NE. Sept. 6, 2 (Allin, 1943).
1950: Junction of Asheweig and Winisk Rivers (Lat. 54.25°; Long. 87.5°). C. A. Elsey observed cranes as follows: May 9, 2; May 11, 1; May 16, heard; May 17, 2; May 22, 2. The Indians of the region, when they observed a picture of the Sandhill Crane, reported that cranes nested there regularly (Baillie, 1951, and letter from Elsey, March 10, 1952). Nikip Lake, near the headwaters of the Severn River (Lat. 52.5°; Long. 91.5°). A. T. Cringan worked here steadily from June 6 until Sept. 9 in the field and heard cranes on June 30 and Aug. 26, and observed 2 on Aug. 3. Wawa Lakes, between Kapuskasing and Moosonee. A. S. Hawkins observed 2 cranes June 24 (letter, Feb. 14, 1952, and Baillie, 1951).
1952: Thunder Bay Dist., Lappe. Oct. 9, 1952, specimen of *G. c. canadensis* (Baillie, 1953).
1955: North shore of Lake Ontario, Oshawa Marsh. May 8, 1 (Baillie, 1955).
1957: Point Pelee. Oct. 5, 1 (Bennett *et al.*, 1958).
1958: Moosonee, 9 mi. east. May 23, 2; May 24, 1 (Gunn, 1958).

In addition to the above records there is a specimen (Nat. Mus. Canada) taken at Beaumaris.

MICHIGAN

(See Fig. 4)

SPRING MIGRATION

Monroe Co., Petersburg. Earliest, March 8, 1892 (9-year average, March 15) (Cooke, 1914). Erie Twp., March 24, 1940, 4 in flight (W. Anderson in letter).

St. Joseph Co., Lockport and Fabius Twps. April 11, 1926, 1; March 20, 1947, 2 in flight (O. M. Bryens in letter). Constantine Twp., Three Rivers State Game Area. March 20, 1952, 3 in flight.

Berrien Co., Paw Paw Lake. March 30, 1952, flocks of 5 and 17 in loose circling formation drifting NW at 500 feet (A. Ammann, letter).

Kalamazoo Co., Ross Twp., W. K. Kellogg Bird Sanct. March 21, 1941, 2 in flight; March 22, 1941, 3 in flight (M. D. Pirnie, verbal comm.). Oshtemo, 2 mi. east. April 8, 1951, 1 (J. B. Fleugel, verbal comm.). Gourdneck State Game Area. March 14, 1952, 3 (A. Ammann, State Cons. Dept. notes).

FIG. 4. The Sandhill Crane in Michigan. ○—Migration records outside known breeding areas. ●—Known breeding areas.

Calhoun Co., 6 mi. north of Union City. March 5, 1951 (3–4 p.m.), 6 flying north at 300–400 feet (W. A. Dyer, verbal comm.). Convis Twp., B. W. Baker Sanct. area (including a 3-mi. radius). April 3, 1932, 2; March 26, 1933, 3; March 25, 1934, 3; March 14, 1935, 5; April 9, 1936, 2; March 25, 1937, 2; March 26, 1938; March 22, 1939; March 24, 1940, 2; March 22, 1941, 1; March 15, 1942, 2; March 18, 1943, 6; March 7, 1944; March 13, 1945, 2; March 7, 1946, 2; March 20, 1947, 1; March 20, 1948, 4; Feb. 26, 1949, 1; March 18, 1950, 1; March 6, 1951, several heard in p.m.;

March 8, 1952, 2; March 11, 1953; March 18, 1954, 3; March 10, 1955, 3 and 1; March 3, 1956, 2; March 14, 1957, 1; March 5, 1958, 2; March 11, 1959, 2; March 18, 1960, 3 (Walkinshaw, 1950*a*).

Jackson Co., Springport Twp., Sects. 2, 10, 21. March 17, 1952; March 21, 1953, 4; Feb. 25, 1955, 2; March 17, 1957, 2. Waterloo Twp. March 5, 1922, 4; March 20, 1923, 2; April 10, 1926, 2; March 25, 1929. Sections 26 and 27. March 24, 1936; March 22, 1937; March 20, 1938; March 15, 1939; March 24, 1940; March 22, 1941; March 19, 1942. Sect. 30. March 4, 1945; March 8, 1946; March 13, 1947; March 10, 1949, 7; March 8, 1952; March 12, 1953, heard; March 12, 1955, 2; March 10, 1956, 1–7, by three different groups; March 16, 1957, 2 at Spring Lake. Sect. 35. March 22, 1958, 6 in 3 areas.

Leoni Twp., Sect. 2 (now the Phyllis Haehnle Mem. Sanct.). March 28, 1937, 3; March 23, 1939, 2; March 31, 1940, 6; March 23, 1941, 7; March 12, 1942, 2; March 3, 1951, 1; March 10, 1952, 8; March 12, 1953, 3; March 17, 1954, 4; March 4, 1955; March, 1956; March, 1957; March 11, 1958, 3; March, 1959. Summitt Twp. March 24, 1954, 2. Norvell–Grass Lake Twps., Bessey Lake. March 28, 1954, 2. Jackson. Feb. 28, 1948 (Wallace and Black, 1948); March 7, 1953, 9 (Wickstrom, 1953). Jackson, 3 mi. SE. March 12, 1953 (11 a.m.), 3 flying NE at 1000 feet.

Washtenaw Co. March 12, 1933, 4 (J. R. Greeley, Univ. Mich. notes); March 3, 1936, 3 in flight (N. A. Wood, verbal comm.). Sharon Twp., Sect. 8. March 27, 1941, 3; March 22, 1953, 2; March 28, 1954, 5. Lyndon Twp., Boyce Lake. March 12, 1955, 3; March 21, 1956, 2; March 27, 1957, 2; March 22, 1958, 8.

Wayne Co., Plymouth. March 14, 1945, 3 flying in westerly direction. Dearborn. March 14, 1949, 14 flying west (O'Reilly, 1951). Grosse Ile. March 21, 1952 (Wickstrom, 1952).

Allegan Co., Fillmore. March 6, 1942, in flight (N. T. Peterson, verbal comm.).

Barry Co., Johnstown Twp., Sect. 24. March 23, 1941, 1; March 20, 1942, 2; March 28, 1947, 1; March 26, 1948, 1; March 15, 1955, 1; March, 1959, 1. Prairieville Twp., Baker Lake. March 3, 1951, 3 in flight (M. D. Pirnie, verbal comm.).

Eaton Co., Bellevue Twp. March 22, 1939 (D. Hall, verbal comm.).

Ingham Co., Meridian Twp., Sect. 2. March 29, 1952, heard (M. D. Pirnie, verbal comm.). Locke. Feb. 19, 1857; March 19, 1858; March 16, 1859; March 8, 1860; April 2, 1861; March 27, 1862; March 31, 1863; April 12, 1864; March 20, 1865; April 3, 1866; March 25, 1867; March 13, 1868; March 28, 1869; March 31, 1870; March 9, 1871; March 28, 1872; March 19, 1873; March 20, 1874; March 27, 1875; April 8, 1876; March 30, 1877; March 15, 1878; April 9, 1879; March 30, 1880; March 29, 1881; March 1, 1882; March 13, 1883 (Atkins, 1884). Stockbridge. March 25, 1929; March 23, 1930. Lansing. March 25, 1950 (Wickstrom, 1950).

Livingston Co., Unadilla. March 24, 1911, flock of about 20 (Wood, 1951:144–145); March 13, 1952, 2; March 10, 1955, 5; March 22, 1958, 2. Iosco Twp., Sects. 24, 35, 36. March 26, 1939, 2; March 27, 1941, 3; March 22, 1952, 2.

Ionia Co., Woodbury. March 27, 1932, calling flock flying north in low clouds in early p.m. (birds not seen).

Clinton Co., Bath Twp., Park Lake. March 24, 1934; March 19, 1935. Corey Marsh, 2½ mi. NE of Park Lake. March 12, 1936; March 8, 1937; March 13, 1938, 3; March 14, 1939, 2; March 27, 1940; March 23, 1941, 4; March 19, 1942, 2; March 14, 1943; March 11, 1944; March 1, 1946; March 18, 1947, 3; March 17, 1948; March 8, 1949 (10:30 a.m.), 3; March 23, 1950; March 6, 1951; March 10, 1952; March 11, 1953, 2; March 12, 1954, 3; March 15, 1955, 2; March 10, 1956, 3; March 14, 1957, 3; March 18, 1958, 3; March, 1959. Rose Lake Expt. Station. March 19, 1939; March 25, 1940,

3; March 24, 1941, 4; March 24, 1942, 4; March 14, 1943, 2; March 17, 1944, 5; March 15, 1945, 2; March 1, 1946, 3; March 20, 1947, 1; March 17, 1948; March 7, 1949; March 13, 1950; March 6, 1951; March 19, 1952, 1; March 11, 1953; March 12, 1954; March 15, 1955; March 10, 1956, 3; March 14, 1957, 3; March 18, 1958, 3; March, 1959. Victor Twp., Sects. 28, 32, 33. March 2, 1953 (Wickstrom, 1953); March 13, 1955, 2 heard; March 11, 1956, 4.

Ottawa Co., Allendale Twp., Sects. 17, 21. April 8, 1951, 15 in flock flying north at 100 feet on bright sunny day (P. Hovingh, J. Ponshair, verbal comm.).

Muskegon Co., T9N, R15W, Sect. 36. May 3, 1954, 5 on ground had been there 10 days (Mich. Dept. Cons. notes).

Lapeer Co., Imlay City. March 15, 1945, 5 (Wallace, 1945).

Lake Co., Luther. April 7, 1955, 4 (Black, 1955).

Iosco Co., Hale. April 26, 1953 (Wickstrom, 1953).

Oscoda Co., Mio. April 7, 1955, 10 in flight (Black, 1955).

Otsego Co., T32N, R1W, Sect. 4. May 5, 1940, 2 (H. Tubbs in letter).

Cheboygan Co., Afton. April 1, 1953, 2 flying at 60 feet northward (E. Shultz, verbal comm.).

Schoolcraft Co., Blaney Park. April 4, 1935; April 10, 1936, 2; April 17, 1940, 2; April 13, 1941, 1; April 11, 1942, 2; March 31, 1943, 2; April 11, 1944, 1; March 25, 1945; March 12, 1946, 1; April 13, 1947, 2; April 5, 1948, 1; April 10, 1949, 1; April 8, 1950, 2; March 29, 1952; April 4, 1953, 2; April 6, 1954; April 16, 1958, 1. Seney National Wildlife Refuge. April 12, 1936; April 8, 1937; March 29, 1938, 2; April 5, 1939, 4; April 13, 1940, 1; April 3, 1941, 1; April 2, 1942, 2; April 8, 1943; April 15, 1944; April 13, 1945; March 28, 1946; April 11, 1947; April 7, 1948; March 29, 1949; April 17, 1950; April 10, 1951; April 9, 1952; April 16, 1953; April 6, 1954; April 3, 1955; April 7, 1956; April 2, 1957; April 9, 1958; April 4, 1959, 4 (U.S. Fish and Wildlife Service Notes).

Luce Co., McMillan. April 15, 1922; April 2, 1925, 2; April 25, 1929, 1; April 10, 1932, 2; April 20, 1934, 1; April 13, 1935, 7; April 16, 1939, 2; April 21, 1940, 1; April 7, 1941, 1; April 15, 1942, 1; April 17, 1943, 1; April 8, 1945, 2 (O. M. Bryens, letter).

Chippewa Co., Rudyard. April 20, 1958, 2 (Kenaga, 1958).

FALL MIGRATION

Ontonagon Co. Nov. 18, 1955, 2 flying south (E. Bacon in letter to M. D. Pirnie).

Delta Co., T43N, R18W, Sect. 32. Oct. 8, 1931, 9. T43N, R19W, Sect. 15. Oct. 8, 1931, 23 (K. Christofferson, letter).

Alger Co., T47N, R17W, Sect. 33. Sept. 12, 1949 (Nelson, 1950).

Schoolcraft Co., Seney. Sept. 25, 1895 (Barrows, 1912:151). Seney National Wildlife Refuge. Sept. 12–24, 1936; Oct. 14, 1939; Oct., 1939, 80 in one flock; Oct. 16, 1940, 25; Oct. 2, 1941, 26; Oct. 19, 1943; Oct. 8, 1944; Oct. 28, 1945; Oct., 1946; Oct. 6–9, 1947; Sept. 27, 1948; Sept. 15, 1949; Oct. 8, 1950; Oct. 1, 1951; Sept. 20, 1952; Oct. 11, 1953; Sept. 14, 1954; Oct. 3, 1955; Sept. 18, 1956; Sept. 25, 1957; Sept. 7–13, 1958 (notes from Seney National Wildlife Refuge). Blaney Park. Oct. 10, 1939, 6; Sept. 13, 1940, 4; Sept. 26, 1946, 1; Sept. 25, 1947, 2; Sept. 19, 1948, 2; Sept. 20, 1949, 2; Sept. 30, 1950, heard; Sept. 23, 1952, 4; Sept. 12, 1953, 3; Oct. 22, 1954, 1. Manistique. Sept. 19, 1935, 18 (K. Christofferson, letter).

Luce Co., T45N, R11W, Sects. 9, 10. Sept. 15, 1929, 2; Sept. 29, 1930, 8; Sept. 8, 1931, 4; Oct. 8, 1931, 14; Sept. 21, 1932, 2; Oct. 18, 1935, 10; Oct. 3, 1936, 3; Oct. 9, 1939, 14; Oct. 15, 1942, 15; Sept. 16, 1945, 1 (O. M. Bryens in letter). Sleeper Lake,

T48N, R10W, Sects. 33, 34. Sept. 4, 1950, flocks totaling 54 at roost; Oct. 7, 1950, only 3 in same roost. Swamp Lakes, T49N, R9W, Oct. 4, 1945, 75 in one flock. Newberry. Sept. 24, 1945, 36 flying low to south and calling.

Chippewa Co., Whitefish Point. Oct. 2, 1929, male collected (Wood, 1951:146). Fibre. Oct. 1, 1936, 9 (Wood, *ibid.*).

Cheboygan Co., Mackinac City. Sept. 30, 1953 (11 a.m.), 28 flying fairly high southeast over straits (A. Ammann in letter).

Otsego Co., Grass Lake, T32N, R1W, Sect. 5. Oct. 1, 1958, 43 flying south (A. Ammann in letter).

Grand Traverse Co., Weather Lake. Sept. 7–8, 1955, 2 (H. Mahan).

Missaukee Co., Lake City, 2 mi. SE. Oct. 6, 1951, 22 flying south and calling at 10 a.m. (M. D. Pirnie in letter).

Ottawa Co. Oct. 23, 1909, specimen in Grand Rapids Museum (Wood, 1951).

Clinton Co., Bath Twp., Rose Lake Expt. Station and Corey Marsh. Nov. 16, 1935; Oct. 9, 1938, 2; Oct. 1, 1939, 23; Oct. 25, 1940, 2 (peak, Oct. 11—16 cranes); Oct. 15, 1941, 2; Oct. 17, 1942, 4; Oct. 3, 1943, 17; Oct. 14, 1944, 20 and 7; Oct. 5, 1946, 12 and 8; Oct. 23, 1947, 1; Oct. 13, 1950, 11; Oct. 16, 1950, 4; Oct. 15, 1951, 14; Oct. 15, 1952, 50–65 flying; Oct. 15, 1953; Oct. 3, 1954, 13; Oct. 21, 1956, 17; Oct. 22, 1958, 4 (C. T. Black in letter). Bath Twp., Park Lake. Oct. 1, 1950, 50 flying (E. Goff in Mich. Dept. Cons. notes).

Barry Co., Johnstown Twp., Sect. 25, and Assyria Twp., Sect. 19. Nov. 9, 1957, 2; Nov. 19, 1958, 5; Nov. 10, 1959, 8.

Ingham Co., east of Lansing. Nov. 9, 1947, 50 flying SE in V-formation at 400 feet and occasionally calling. Stockbridge. Oct. 14, 1929, 4.

Livingston Co., Putnam Twp., T1N, R4E, Sect. 30. Dec. 15, 1946, 2 (F. N. Hamerstrom, Jr., in letter). Iosco Twp. Oct. 17, 1951. Unadilla Twp., Sect. 31. Oct. 8, 1955.

Calhoun Co., Convis Twp., Sects. 3, 6, 10, 11, 14, 15. Oct. 13, 1934, 8; Oct. 6, 1938, 2; Oct. 1, 1939, 16; Nov. 3, 1940, 9; Oct. 24, 1941, 3; Oct. 8, 1942, 3; Nov. 11, 1943, 2; Nov. 12, 1944, 1; Nov. 15, 1945, 2; Nov. 16, 1946, 2; Nov. 9, 1947, 5; Nov. 25, 1948, 7; Nov. 20, 1949, 14; Nov. 10, 1950, 6; Oct. 28, 1951, 10; Nov. 1, 1952, 12; Nov. 15, 1953, 9; Nov. 13, 1954, 4; Nov. 9, 1955, 29; Nov. 10, 1956, 4; Nov. 2, 1957, 11; Nov. 22, 1958, 5; Nov. 15, 1959, 11. From 1943–1959 the last dates are within 2 days or less of actual departure dates.

Jackson Co., Springport Twp., Sects. 10, 11, 15. First week of Nov., 1952, 5 (O. C. McPherson, verbal comm.). Leoni Twp., Sect. 2. Oct. 24, 1935, 2; Oct. 7, 1949, 9; Oct. 22, 1950, 5; Nov. 2, 1957, last; Oct. 14, 1958, 91; Oct. 1, 1959, 66. Waterloo Twp., Portage Marsh, Portage Lake, Whitehead Lake. Oct. 4, 1936, 3; Oct. 24, 1937, 5 (Wood, 1951); Oct., 1938, 56 (W. Moechel, verbal comm.); Oct. 20, 1940, 9 (peak Oct. 6—46 cranes); Oct. 19, 1941, 8 (peak Oct. 9—45 cranes); Nov. 6, 1942, 20 (peak Oct. 17—48 cranes); Oct. 14, 1943, the last (Oct. 10—36 cranes); Oct. 15, 1944, 40; Oct. 15, 1945, 10 (peak Oct. 6—38 cranes); Oct. 16, 1950, 16 (peak Oct. 14—46 cranes); Oct. 14, 1951, 84; Oct. 12, 1952, 98 (last on Oct. 30—2 cranes); Oct. 7, 1953, 99; Oct. 10, 76; Oct. 17, 31; Oct. 2, 1954, 81; Oct. 10, 2; Oct. 8, 1955, 80; Oct. 5, 1957, 127; Oct. 6, 131; Oct. 4, 1958, 107. Norvell Twp., Sect. 33. Oct. 1, 1954, 2 (M. D. Pirnie, verbal comm.). Manchester. Nov. 24, 1896 (Cooke, 1914:13). Hanover Twp., Sect. 8. Oct. 1, 1952 (C. Owens, letter).

Washtenaw Co., Lyndon Twp. Oct. 25, 1900. Sect. 8. Oct. 21, 1951, 30; Oct. 10, 1953, 35; Oct. 17, 1953, 28; Oct. 10, 1954, 47; Oct. 2, 1955, 77; Oct. 8, 1955, 67; Oct. 6, 1957, 65; Oct. 10, 36; Oct. 4, 1958, 53; Oct. 14, 45; Oct. 23, 33. Sect. 19. Oct. 13,

1940, 33. Dexter Twp.–Lima Twp., 4-mile Lake. Sept. 27, 1953, 4. Sharon Twp., Sect. 8. Oct. 19, 1930, 10; Oct. 8, 1955, 9.

Cass Co. Sept. 3, 1950, 1 (Wickstrom, 1951).

Monroe Co., Erie Twp. Oct. 19, 1948, 3 in flight (Wallace and Black, 1949).

WISCONSIN

SPRING MIGRATION

Rock Co., Johnstown. April 4, 1894, specimen of *G. c. canadensis* (Kumlien *et al.*, 1951:29); March 30, 1958, 8 flying (MacBriar, 1958).

Racine Co., Racine. April 13, 17, and 20, 1946 (Barger, 1946*b*).

Dane Co. March 21, 1948, 2 (Robbins, 1948*b*). Madison. May 14, 1943, 2 (Barger, 1943*b*); April 15, 16, 1947, 69 (Robbins, 1947*b*); April 27, 1949, 2 (Robbins, 1949*b*). Mazomanie. March 31, 1950, 2 (Robbins, 1950*b*).

Jefferson Co. April 2, 1950, 2 (Robbins, 1950*b*); March 27, 1952, 1 (Strelitzer, 1952); April 4, 1954 (Besadny, 1954*c*); April 15, 1957 (Lound and Lound, 1957*b*). Busseyville. April 26, 1869, flying north in night (Schorger, 1944).

Waukesha Co. May 13, 1954 (Besadny, 1954*d*); March 30, 1940, 4 (Barger, 1940*b*). Waukesha. April 7, 1950, 16 (Robbins, 1950*b*).

Sauk Co., Sauk City. May 8, 1938, 2 (Grange, MS).

Columbia Co. March 27, 1954 (Besadny, 1954*c*). Poynette. May 7, 1940, 2 (Barger, 1940*c*); March 22, 1941, 24 (Barger, 1941*b*); April 14, 1947 (Robbins, 1947*b*); May 2, 1957 (Lound and Lound, 1957*b*); April 27, 1958 (MacBriar, 1958).

Dodge Co. April 3, 1898, 9; April 5, 1900, 1 shot; April 7, 1900, 1; April 8, 1904, flock; April 22, 1924, flock (notes from W. E. Scott). Horicon. May 5, 1942 (Barger, 1942); March 19, 1945, 25 (Smith and DuMont, 1945); April 1, 1950, 10; April 7, 1950, 34; April 9, 1950, 1 (Robbins, 1950*b*); March 31, 1957, 9 (Lound and Lound, 1957*b*). Kekoskee. April 8, 1944, 75 (Barger, 1944).

Monroe Co. Feb. 28, 1951, 2 (Grange, MS).

Juneau Co., Clearfield. April 20, 1939, 3 (Laboda, 1939).

Adams Co. April 14, 1953 (Besadny, 1953); April 30, 1954 (Besadny, 1954*c*); April 6, 1955 (Foster, 1955); April 8, 1957 (Lound and Lound, 1957*b*); April 3, 1958 (MacBriar, 1958).

Marquette Co. Jan. 8, 1941, 1 dead and 1 alive (Barger, 1941*a*). Endeavor Marsh. March 29, 1943, 2 (Barger, 1943*b*); May 20, 1944, 4 (Barger, 1944); April 10, 1935, 300 (B. Kimball in report to Aldo Leopold).

Green Lake Co. April 20, 1950 (Robbins, 1950*b*); April 15, 1951, 26 flying over (Strelitzer, 1951); March 28, 1952, 12 (Strelitzer, 1952). Town of Seneca, Sect. 16. April 30, 1949, 400 plus (N. A. Damaske, pers. comm.); May 11, 1950, 70 plus. Sect. 17. April 25, 1950, 36; May 11, 1950, 42. Sect. 3. May 11, 1950, 600 in flight. Town of St. Marie. April 30, 1949, 250 plus; April 25, 1950, 10.

Waushara Co. March 30, 1940 (Barger, 1940*a*).

Manitowoc Co. May 17, 1950, 2 (Robbins, 1950*c*); May 12, 1956 (Lound and Lound, 1956).

Calumet Co. March 23, 1949, 25 flying west (Grange, MS).

Jackson Co., Hoffman–Stebbins Range, T20–21N, R1E. Late March, 1936, April 9, 1937 (Hamerstrom, 1938). April 25, 1957, 7 (Lound and Lound, 1957*b*).

Wood Co. March 29, 1942 (Mathiak, 1942); April 4, 1949, 2 (Robbins, 1949*b*); March 29, 1952 (Strelitzer, 1952). Cranmoor. April 1, 1929 (Grange, MS). Babcock, Sandhill Game Farm. April 9, 1937; March 28, 1950; March 21, 1952, 4 (Grange, MS). Wisconsin Rapids. April 1, 1947 (Robbins, 1947*b*).

Outagamie Co. April 28, 1954 (Besadny, 1954*c*). Shiocton. April 17, 1947, 15 (Robbins, 1947*b*); March 29, 1958 (MacBriar, 1958).

Shawano Co. June 1, 1950 (Robbins, 1950*b*).

Polk Co. April 29, 1950 (Robbins, 1950*b*).

Burnett Co. May 10, 1952 (Strelitzer, 1952); April 9, 1956 (Lound and Lound, 1956); April 2, 1957 (Lound and Lound, 1957*b*); April 4, 1958 (MacBriar, 1958).

Sawyer Co. May 5, 1941 (Barger, 1941*c*).

Ashland Co., Outer Is. May 23, 1950, 2 (Robbins, 1950c).

FALL MIGRATION

Vilas Co. Sept. 27, 1958 (Kemper, 1959).

Barron Co. Oct. 8, 1957, 1 (Lound and Lound, 1958).

Burnett Co. Sept. 4, 1956 (Lound and Lound, 1957*a*).

Dunn Co. Oct. 1, 1953 (Besadny, 1954*a*).

Chippewa Co. Oct. 1, 1957, 1 (Lound and Lound, 1958).

Oconto Co., Peshtigo Marsh. Sept. 3, 1940, 3 over (Barger, 1940*d*).

Shawano Co. Aug. 27, 1953, 6 (Besadny, 1954*a*).

Trempealeau Co. Nov. 2, 1953 (Besadny, 1954*b*).

Jackson Co., Grimshaw Range. Oct. 20, 1936, most cranes gone; Nov. 8, 1936, last 2 left (Hamerstrom, 1938).

Wood Co. Oct. 10, 1936; Oct. 6, 1957 (Lound and Lound, 1958). Pittsfield. Sept. 20, 1924. Remmington. Oct. 3, 1939, 3 (Scott, 1939*b*). Babcock. Nov. 6, 1950 (Robbins, 1951*b*). Amundson Cranberry Marsh. Oct. 15, 1940, 14; Oct., 1941, 21; Oct., 1948, 21 (Grange, MS). Babcock, Sandhill Game Farm. Oct. 16, 1949, 31; Oct. 28, 1950, 25 (Oct. 24—55 cranes); Oct. 31, 1951, 30 plus (Oct. 21 and 22—34 cranes); Oct. 15, 1952, 22 (earlier Oct.—46 cranes) (Grange, MS). Babcock, Y-ditch. Oct. 28, 1949, 44 (Grange, MS).

Outagamie Co., Shiocton. Oct. 9, 1882 (Gruntvig, 1894–1895:100); Oct. 11, 1949, 8 (Robbins, 1950*a*). New London. Oct. 14, 1928; Oct. 20, 1935; Nov. 7, 1938 (supplied by U.S. Fish and Wildlife Service); Oct., 1940, 34 (Barger, 1940*f*); Oct. 3, 1941, 17 (Dayton, 1941); Oct. 18, 1949, 15 (Robbins, 1950*a*); Sept. 21, 1955 (Foster, 1956); Sept. 15, 1956 (Lound and Lound, 1957*a*); Oct. 1, 1957 (Lound and Lound, 1958).

Adams Co. Sept. 21, 1941, 19 (Barger, 1941*d*); Oct. 4, 1941, 2 flocks—75 and 200 cranes; Sept. 28, 1942, 200 (A. Leopold in notes); Oct. 17, 1947, many (Robbins, 1948*a*); Oct. 23, 1948, large flock (Robbins, 1949*a*); Oct. 22, 1953, 2 (Besadny, 1954*a*); Sept. 14, 1954 (Besadny, 1955); Sept. 26, 1955, last (Foster, 1956). Ship Rock. 100 left before Oct. 20, 1934. Near Hancock. Oct. 8, 1939, 75–100 (Scott, 1939*b*). Town of Colburn. Oct. 8, 1940, 52 (Barger, 1940*e*); Oct. 3, 1957 (Lound and Lound, 1958).

Waushara Co. Nov. 5, 1948, 46 (Robbins, 1949*a*); Sept. 12–Oct. 8, 1950, flocks (Robbins, 1951*a*). Wild Rose. Sept. 16, 1950, 28; Sept. 17, 1950, 34 (Grange, MS). Wautoma. Sept. 6, 1952 (9:35 a.m.), 2; (4:55 p.m.), 6 (Grange, MS).

Marquette Co., Endeavor Marsh. 1892, 1000 (Grange, MS); Sept. 30, 1939, 8 (Scott, 1939*a*); Oct. 12, 1939, 36; late Oct., 1940, 150 (Barger, 1940*e*); Nov. 4, 1941, large flock (Barger, 1941*e*); Sept. 15, 1946, 14; Sept. 28, 1946, 50 (Robbins, 1947*a*); Sept. 21, 1948, 29 (Robbins, 1949*a*); Sept. 12 to Oct. 8, 1950, flocks (Robbins, 1951*a*); Sept. 21, 1953, 2 (Besadny, 1954*a*); Oct. 15–22, 1955, peak (Foster, 1956). Nashkoro Twp., T17N, R11E, Sect. 34. Sept. 12, 1950, 6 (N. Damaske in letter). Between Briggsville and Endeavor. Oct. 10–16, 1954, large flock (Besadny, 1955).

Green Lake Co. Sept. 13, 1946, 63; Oct. 7, 1947, 250 (Robbins, 1948*a*; Grange, MS); Oct. 8, 1948; Oct. 17, 1948 (Robbins, 1949*a*); early Oct., 1949, 700 (Robbins, 1950*a*);

Sept. 12 to Oct. 8, 1950, large flocks (Robbins, 1951*a*); Oct. 15, 1952, 1400—in part in Marquette Co. (last on Nov. 15) (Strelitzer, 1953); Oct. 22, 1953, 37 (Besadny, 1954*a*); Sept. 24, 1954, 400 (Besadny, 1955); Oct. 15–22, 1955, peak (Foster, 1956); Sept. 27 to Oct. 18, 1956 (Lound and Lound, 1957*a*); Oct. 5–6, 1957 (Lound and Lound, 1958). Lake Puckaway. Oct. 22, 1933, 20 flying over (Grange, MS). Near Princeton. Sept. 25 to Oct. 3, 1941, 90 (Scott, 1941); Sept. 20, 1953, 175 (Besadny, 1954*a*); Sept. 30, 1958, 300 (Kemper, 1959). Town of Seneca, Sects. 16, 17. Oct. 16, 1949, 600; Sept. 14, 1950, 36; Oct. 12, 23; Oct. 31, groups of 36 and 75 (N. Damaske in letter). Sect. 9. Oct. 31, 1950, 125. Sect. 20. Sept. 2, 1950, 3. Sect. 11, R11E. Sept. 11, 1950, 31 (N. Damaske in letter). Town of St. Marie, Sect. 31. Oct. 16, 1949, 200 plus; Oct. 12, 1950, 20; Oct. 31, 15 (N. Damaske in letter).

Sheboygan Co., West of Cedar Grove. Sept. 24, 1936, 1; Oct. 1, 1937, 7 (notes from W. E. Scott).

Columbia Co., Poynette. Oct. 16, 1940, 31 (Barger, 1940*e*) (Grange gave Oct. 15); Oct. 4, 1957 (Lound and Lound, 1958).

Dodge Co. Oct. 18, 1892, flock; Sept. 20, 1901, flock. Horicon Marsh. 1864 (?), 300—1 shot; Nov. 26, 1945, 1; Nov. 6, 1948, 40 (Barger, 1946*a*; Robbins, 1949*a*). Mud Lake. Oct. 20, 1949 (Robbins, 1950*a*).

Dane Co. Sept. 27, 1953 (Besadny, 1954*a*); Oct. 24, 1955, 6 flying south (Foster, 1956).

Jefferson Co. Oct. 17–18, 1942, few (Barger, 1943*a*); Oct. 4–19, 1950 (Robbins, 1951*a*); Oct. 12, 1956 (Lound and Lound, 1957*a*:37).

Waukesha Co. Sept. 20, 1949, 12 (Robbins, 1950*a*).

Milwaukee Co., a few miles north of Milwaukee. Dec. 10, 1939, 1 (Scott, 1940).

Rock Co. Oct. 28, 1949 (Robbins, 1950*a*).

Walworth Co. Nov. 6, 1940, 18 (Barger, 1940*f*). Delavan. Oct. 23, 1892 (Cooke, 1914:13); Oct. 3, 1897 (spec. Milw. Pub. Mus.). Lake Geneva. Nov. 4, 1937, 4 flying over lake (Grange, MS); Oct. 5, 1954, 50 (Besadny, 1955).

Kenosha Co. Oct. 19, 1947, 25 flying NW at New Munster (Robbins. 1948*a*; Grange, MS).

Conclusion

Since 1910 apparently the majority of Sandhill Cranes have migrated from northern Ontario, northern Michigan and central Wisconsin, into northern Indiana; and in more recent years to Jasper–Pulaski Game Preserve. From here and from southern Michigan cranes definitely proceed toward southern Georgia, and apparently on into Florida.

Migration records are shown on Fig. 1. But more significant are the numbers of cranes observed. In western and southern Illinois, there are only five recent records, only three of which indicate the exact numbers, totaling six cranes. From eastern Illinois I have obtained information on 31 groups of cranes, but exact numbers were available in only five records, totaling 100 cranes. Outside of the Willow Slough and Jasper–Pulaski Game Preserve in northern Indiana, where the cranes concentrate for many weeks, I find 57 observations of cranes listing a total of at least 703 birds. Farther east in Ohio there are only 14 records totaling at least 78 cranes, and these mainly from the western part of the state. Records from Massachusetts, Pennsylvania, West Virginia, New Jersey, and South Carolina in recent years give

no more than one or two cranes in a group. In Kentucky there are only five recent records totaling 39 cranes. In western Tennessee only one record of two cranes; while in eastern Tennessee there are eight records totaling 84 cranes. On the other hand, 1294 migrating cranes have been counted in 27 groups going over Georgia. The line of flight appears to be from the northwestern part of the state through the Atlanta region and the Piedmont National Wildlife Refuge area to the Okefenokee Swamp area. Usually there appears to be no winter increase in the cranes in the Okefenokee National Wildlife Refuge, but during the winter of 1956–1957, 522 were counted on January 29. A winter increase in Florida, together with observed flights in March and November in the northern part of the state, indicate the regular wintering area is usually in central or southern Florida.

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ORIENTED OVERLAND SPRING MIGRATION OF PINIONED CANADA GEESE

BY WILLIAM J. HAMILTON III AND MERRILL C. HAMMOND

SEVERAL attempts have been made to re-establish breeding flocks of Canada Geese (*Branta canadensis*) on former nesting ranges in the north-central states. In recent years the United States Fish and Wildlife Service has trapped both young and adult wild birds and released them as pinioned adults in large enclosures on potential breeding marshes. Geese were trapped from the fall concentration at Swan Lake National Wildlife Refuge at Sumner, Missouri. Band returns suggest that these birds are from the Eastern Prairie population of *B. c. interior* whose breeding range centers along the western edge of Hudson Bay between Fort Severn and Fort York (Hanson and Smith, 1950).

In the years following restocking of refuges in Minnesota, Nebraska, and North and South Dakota, no pair-formation or nesting occurred, even though most of the birds reached a minimum age of five years. Birds that escaped from the enclosures, or that were liberated in unfenced marshes, showed a definite tendency to move northward. This paper documents the nature and extent of these overland spring movements by flightless geese.

OBSERVATIONS

In the following discussion, northward movements are described in terms of distance and direction of travel. The true azimuth from the point of release to the sighting or recovery is reported in parentheses following the record. Thus, 360° means a movement directly to the north, 010° a movement 10 degrees east of north. When satisfactory evidence indicates that the observation is of a previously reported group, the azimuth is from the last sighting. The magnetic deviation for this area is about 11° east.

Mud Lake Refuge, Holt, Minnesota.—Over 100 pinioned captive Canada Geese, primarily birds wild-trapped at Swan Lake in 1951 and 1952, were being held at the Mud Lake Refuge in 1955. Shortly before May 20, 1955, 60 to 70 of these geese escaped from their pen. On May 20 and May 31 several birds from the flock were recaptured by refuge personnel in a field on the open prairie 6 miles north of the pen (360°). Some of those birds which escaped were later sighted in a field a half mile south of Thief Lake, 10 miles north of the release pen (011°). None of these birds were recaptured and apparently all perished during the hunting season that fall. The point of escape did not connect directly to any watercourse, and the intermediate sightings and recaptures in open farmland suggest that the Thief River to the east was not used as a travel route. Thief Lake was not visible to the birds from the pen.

Valentine Refuge, Valentine, Nebraska.—With the clearing of ice in April, 1956, 50 geese from Swan Lake were released from an 11-acre pen at Pony Lake on the Valentine Refuge. In May two groups of geese (9 and 16 individuals) were recaptured on the

southern end of Ballard State Marsh, 6.9 (358°) and 6.4 (006°) miles north of Pony Lake. Of the 25 remaining geese, 16 were recaptured in the fall of 1956 on South Marsh Lake, just to the northeast of Pony Lake. Since several geese were sighted north of the Marsh Lakes on Red Deer Lake after the May recapture, it is possible that some of the autumn South Marsh Lake recoveries had returned overland from a more northern area. In April, 1957, 72 geese, including some of the participants in the 1956 movement, were released at Pony Lake. After a few days of delay the flock traveled across the Marsh Lakes and overland to the north. Two birds were recovered on a small temporary pond 9.1 miles (019°) from the release site and the remaining flock of 67 birds was recaptured on rolling ranchland 3.6 miles farther north (359°), 12.7 air miles from the initial release site. In both years the initial movement away from Pony Lake was through an elevated pass to the northeast in spite of a more accessible lowland escape route to the southeast. Having thus reached the Marsh Lakes, water and marshland may have facilitated and directed the movement for the next 3 miles before high country and restricted visibility were again encountered. The final 6 miles of the movement in 1957 passed through rolling hills devoid of natural water sources.

Crescent Lake Refuge, Ellsworth, Nebraska.—In late May of 1957 approximately 120 geese escaped from the pen at refuge headquarters. The majority of these birds were recaptured 2.7 miles to the north (356°) on June 2, 1957. On that date they were still moving north. Near the escape site visible water lay only to the south, yet the initial route took the birds nearly a mile overland to Goose Lake and from there the movement again struck into waterless open country to the north. A chain of lakes to the northeast of Goose Lake would have combined a watercourse with a generally northward (approximately 050°) route, yet the movement did not deflect in that direction.

Arrowwood Refuge, Kensal, North Dakota.—A flock of Swan Lake birds was released from a holding pen adjoining Jim Lake on April 17, 1957. On May 26, 17 of these birds were sighted on the James River 10.8 miles north (353°) of the release site. Several birds, presumably the same group, were sighted on June 17, 6.8 miles north (355°) of the last sighting, and on June 24, 17 geese were captured 3.3 miles still farther north (347°). On May 1, 1958, 24 or 25 geese, including some of the birds recovered from the previous year's migration, escaped from the Jim Lake holding compound. On May 7 three geese were recaptured 2.0 miles north (005°) of the pen. Ten pinioned geese were sighted on May 22 at the point of the May 26, 1957, sighting (353°). On June 4 a farmer reported nine geese in a slough 3.6 miles northeast of the release site (056°), and on June 20 another report located two geese 7.3 miles from the release site (088°). On June 10, and in the following days, between 12 and 18 pinioned geese were reported on the James River east of Grace City, 24.8 miles from the point of release (002°). This undoubtedly included the birds sighted May 22. Much of the movement in 1957 probably followed the course of the James River and its impoundments (Jim Lake, Arrowwood Lake), but both the June 17 and June 24 sightings were away from the river and its tributaries. The main body of the 1958 migration probably also followed the waterways of the James River to the point of the June 10 sighting. It is interesting to note that the location of this sighting was on the north side of the river just past the first point beyond the release site where the river course deviated significantly for any great distance from a generally north-south direction. Where the river turned to the west progress ended. Perhaps further movement to the north was limited by the reluctance of the birds to cross the bed of the Great Northern Railway. The birds recaptured May 7 apparently made the entire journey overland, in spite of the northwesterly course

available on nearby Jim Lake. The birds sighted June 4 and 20 must also have moved almost entirely overland.

Lacreek Refuge, Martin, South Dakota.—On March 21, 1957, approximately 47 Swan Lake birds were released. They remained at the release point until the first week in May when about 32 birds moved out. The first 5 miles of migration was probably over a chain of lakes to the north. Movement to the location of recoveries farther to the north could only have been accomplished by considerable overland movement. On May 29, 1957, 16 geese were recaptured at a stock pond 17.6 miles from the release point (356°) and 11.3 miles beyond the last waterway. Five geese were recaptured in an alfalfa field on June 4, 13.7 air miles (353°) from the release site and 8.1 miles beyond a potentially guiding watercourse. Two other recaptures of three and two birds were made to the north of the release site (333°, 017°).

The results of these observations are summarized in Fig. 1. In addition to the actual movements recorded above, penned birds at Lostwood (North Dakota) and Crescent Lake (Nebraska) refuges regularly crowded the north fence lines in spring and early summer.

Discussion

Timing of migration.—The period of passage for wild Canada Geese at the pertinent refuges is recorded in Table 1, together with the period of movement of the pinioned birds. From these data it is at once apparent that the movement of the pinioned birds started later and continued longer than the natural migration through the area. This can not be accounted for by the tardy release of the captives, since at least one flock (Lacreek) did not initiate movement until over a month after release.

The protracted migration period, well into June, perhaps bears out Merckel's (1956) suggestion that the experiences of birds are important in ending migration once the breeding grounds are reached. The nature of this experience, whether recognition of familiar country, celestial cues or some other change, and how it acts to end migration are two of the many unsolved mysteries of bird migration. The transportation and observation of landbound geese might be a productive method of investigating this problem.

Rate of movement.—Table 2 summarizes those parts of the movements for which the rate of advance by pinioned birds could be accurately determined. The distance traveled per day was found by dividing air distance traveled since the last sighting by the number of intervening days. Some error is thus inherent in these calculations due to differential underestimation of the length of the actual path taken. Observations 2, 6, and 7 represent the progress of the 1957 Arrowwood release, and records 3 and 5 both represent the same fragment of the 1958 Arrowwood release. For these flocks for which more than one report is available there is no indication of a slowing of the movement late in the season when the natural migration of Canada Geese through the area had ended. If the data for all localities are taken together the result

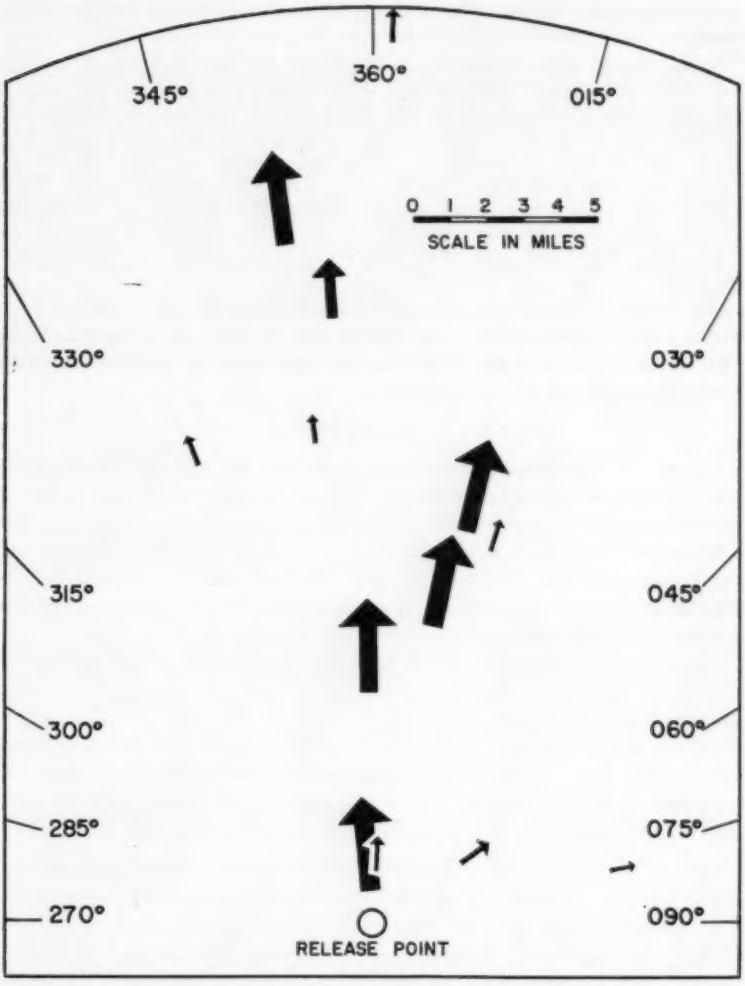

FIG. 1. True compass direction taken by migrating pinioned Canada Geese. The heaviest arrows represent flocks which did not fragment in their movement, the smaller arrows portions of fragmented flocks.

is the same, i.e., no indication of a slowing of the walking migration up to the time the birds were recaptured.

Orientation of migration.—Fig. 1 clearly establishes the northward move-

TABLE 1

TIMING OF MIGRATION OF WILD AND PINIONED CANADA GEESE

Refuge	First arrivals	Main migration	Release of captives	Movement of captives
Mud Lake	3/30/55	4/10 to 4/16/55	5/19 ± 2/55	5/19 to 5/31/55
Arrowwood	3/17/57	4/21/57	5/17/57	until 6/24/57
	3/24/58	4/4 to 4/7/58	5/1/58	5/1 to 6/10/58
Lacreek	2/13/57	3/3 to 3/4/57	3/21/57	5/4 ± 3 to 5/29/57
Crescent Lake	2/17/57	3/10 to 3/23/57	5/20 ± 5/57	until 6/2/57

ment of the released birds during May and June. The conditions of transplantation and release allow some opportunity for analysis of the directional cues which may have been utilized in these movements. Since all the Swan Lake birds had migrated at least once it is possible that some of the birds were familiar with the terrain over which they moved and were following familiar landmarks in an attempt to return to a familiar northern breeding area. But the use of remembered landmarks seems unlikely when we recall the limited horizon of visibility available to a bird with its head less than a meter from the ground and the different perspective from this position.

Recent investigations have demonstrated celestial orientation in a wide variety of avian species (Kramer, 1957; Sauer, 1957), including several species of waterfowl. With his special technique of releasing and following free-flying waterfowl, Bellrose (1958 and personal communication) has recently obtained evidence that the Canada Goose is capable of utilizing celestial cues. Thus, for this species, it is at least possible that the celestial environment was the orienting cue.

The direction of overhead passage of wild migrants could also have provided the necessary orienting cues, at least for the initial movement. Table 3 compares the direction taken by wild migrants and walking geese with the

TABLE 2

RATE OF MIGRATION OF PINIONED CANADA GEESE

Observation number	Refuge	Mean travel date	Date of movement	Nature of terrain	Average miles/day	True azimuth
1	Arrowwood	5/4	5/1 to 5/7/58	overland	.33	005°
2	Arrowwood	5/6	4/17 to 5/26/57	waterways	.36	353°
3	Arrowwood	5/11	5/1 to 5/22/58	waterways	.51	353°
4	Mud Lake	5/25	5/19 to 5/31/55	overland	.50	011°
5	Arrowwood	6/1	5/22 to 6/10/58	waterways	.74	010°
6	Arrowwood	6/6	5/26 to 6/17/57	both	.31	355°
7	Arrowwood	6/20	6/17 to 6/24/57	overland	.47	347°

TABLE 3

DIRECTION TAKEN BY FREE-FLYING AND PINIONED CANADA GEESE

Refuge	Direction of overhead migrants	Miles to probable breeding grounds	True azimuth to probable breeding grounds	Direction taken by walking geese
Mud Lake	Due north	700	011°±10°	360°, 011°
Arrowwood	North to northwest	800	019°±11°	355°, 353°, 353°, 347°, 002°, 005°, 056°, 088°
Lacreek	Almost due north	1100	016° ± 8°	356°, 353°, 333°, 017°
Valentine	———	1100	018° ± 7°	359°, 358°, 006°, 019°
Crescent Lake	North	1250	016° ± 8°	356°

direction to the probable breeding grounds. Such a mimetic mechanism of orientation would not be unexpected in this species where social behavior is such a significant feature of migration, and where tradition has been shown to play a major role in some features of travel (Hochbaum, 1955). However, such overhead migration could not have been the sole orienting cue since much of the oriented movement took place after natural migration had ended.

The importance of guides could conceivably be experimentally investigated by comparing the accuracy of orientation of pinioned birds on relatively featureless terrain with and without overhead migrants. Furthermore, if a bird will orient appropriately while walking over the ground, then some birds could be repeatedly utilized to test diurnal and seasonal variation in intensity and accuracy of orientation. Such a technique could go beyond caged *Zugunruhe* studies in testing the influence of the visual environment, particularly habitat changes and responses to them. In suitably homogeneous terrain celestial orientation responses could be tested in those species which can not be shown to demonstrate directional *Zugunruhe* responses in small cages. But more important, features of social organization and leadership, heretofore largely neglected in experimental studies, might be investigated.

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SUMMARY

Adult pinioned Canada Geese escaped or were released at several National Wildlife Refuges in Minnesota, Nebraska, and the Dakotas, well south of the

natural breeding range of this population. Subsequent sightings and recoveries indicate an accurate northward movement of these earth-bound birds during and after the period of normal goose migration. Overland movements up to 24.8 air miles were recorded. The rate of progress was more or less uniform throughout the season, ranging from .31 to .74 miles per day. The cues guiding the birds northward are not known, but some possibilities are discussed.

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Museum of Vertebrate Zoology, Berkeley 4, California; and United States Fish and Wildlife Service, Lower Souris Refuge, Upham, North Dakota, December 8, 1959

SOME INDIAN MIDDEN BIRDS FROM THE PUGET SOUND AREA

BY LOYE MILLER

At an earlier date (1957) I published the results of a study of some nine thousand bird bones from an Indian midden at The Dalles, Oregon. In consequence, Peabody Museum of Harvard University has more lately invited me to study a comparable collection made by their staff in the Puget Sound area. I am indebted to Mr. Alan L. Bryan of that institution for loan of their material, and for permission to make this study. I have also enjoyed helpful discussions with Dr. Raymond B. Cowles of the University of California at Los Angeles, and with Messrs. Eugene Christman and Wm. J. Hamilton III of the Museum of Vertebrate Zoology at Berkeley, on the subjects of thermals, gliders, and Indian taboos. My thanks are extended to these fellow scientists for their contributions to the work.

The collection here discussed includes about five hundred bones or fragments thereof, which were obtained from nine Indian middens on the shores of Puget Sound. Mr. Bryan refers to them as "shell middens" so I assume that marine shells constitute the major mass. I have little information on fish or mammal remains from the sites, beyond a few mustelid bones and one black bear claw that turned up among the bird remains. Mr. Bryan's correspondence indicates large ungulates to be common, together with small carnivores and marine mammals.

As in the Oregon collection, the bird bones are highly fragmented, for reasons which have thus far eluded me. Curiously, however, a few very fragile bones have been preserved intact. There appears to have been no appreciable mineralization of these bones, such as had progressed to some degree in the Oregon mound. They are stained variously by the matrix but are of firm texture. When held in the Bunsen burner flame they blacken, and give off much smoke of most offensive odor. The Oregon bones reacted very lightly to the flame and gave off little odor. Such evidence as is available suggests much less antiquity for this than for the Oregon site. Charred bones are few, though they are more abundant than in the Oregon collection. The rarity of immature bones suggests that there were no important nesting sites within the radius of the Indians' activities. This is quite in contrast with the Emeryville mound studied by Howard (1929).

The Avifauna

There are many aspects in which the Puget Sound fauna differs from that of the midden at The Dalles. The Washington middens are a salt-water accumulation located in what is known as the Northwest Humid Belt. The Oregon midden is located in the Great Basin Faunal Area, in a semi-arid

TABLE 1
RELATIVE ABUNDANCE OF BIRD FAMILIES BY SITES

Family	Approximate abundance	
	Washington Sites %	Oregon Site %
Gaviidae	14.8	—
Podicipedidae	8.0	—
Pelecanidae	.4	—
Phalacrocoracidae	—	21.8
Anatidae	61.	2.3
Cathartidae	—	16.2
Accipitridae	2.5	27.7
Tetraonidae	.8	.23
Gruidae	.8	—
Rallidae	—	.24
Scolopacidae	.4	—
Laridae	5.9	26.
Alcidae	2.9	—
Strigidae	.4	.49
Corvidae	.8	5.1

environment that is little influenced by the great Columbia River flowing through treeless country. Some faunal differences are therefore to be expected, but not all are so simply accounted for. Table 1 indicates relative abundance of bird families represented in the Washington sites, as compared with the Oregon site.

Unfortunately, the percentages of occurrence in the two mounds are calculated upon slightly different bases, but the over-all picture is not greatly distorted. (The percentages for the Washington sites are based on the number of bones. Those for the Oregon site are based on the number of packages in which the species occur. Exact numbers of bones from the Oregon site are not now available to me.)

DISCUSSION

Some forty years of beachcombing along the Southern California coast and islands have given me a fairly definite picture of what the sea might yield, in the way of birds impaired in vitality or freshly dead and therefore ripe for harvest by various predators. A primitive Indian would surely qualify as one such predator with none too fastidious an appetite. Under stress of food shortage, he might even qualify as a scavenger. It is not unlikely, therefore, that many of the bird bones in our midden represent the food-gathering labor of squaws and children. Every family in Table 1, and most of the genera involved, are represented in my own gleanings as a beachcomber for

skeletal material. Puget Sound is far from the open ocean. Therefore, the shearwaters and fulmars so abundant at times on our beaches, and the Short-tailed Albatross of our Indian middens, are not represented in the Washington collection.

Gaviidae.—Loons of two sizes are abundant, the larger not distinguished from *Gavia immer*. The smaller could include both *G. arctica* and *G. stellata*. Age and sex factors bring about such variation in size and topography of skeletal elements that an unassociated bone, particularly if it be imperfect, is not assignable with confidence to species. I am confident that *G. arctica* is the commoner species, but *stellata* may also be present.

Podicipedidae.—Much the same can be said of the grebe remains. *Podiceps grisegena* and *Aechmophorus occidentalis* are both present. The smaller grebes certainly include *Podiceps caspicus*. Estimates of quantitative relations are not ventured, however.

Pelecanidae.—A single fragment of a humerus is the only record for *Pelecanus*, and there is no cormorant. Both these birds are commonly cast up on the beach, and the cormorant was extremely abundant in the Oregon midden. Both families were abundantly represented in the Emeryville shell mound of San Francisco Bay (Howard, 1929) which, like the Washington sites, was well removed from the shore of the open ocean. Skins of pelicans should have been in demand as clothing for a primitive people, had these birds been abundant in the area. Why the pelicans and cormorants are not well represented is a mystery.

All ciconiiform birds are conspicuous by their absence. Herons, sparingly represented at Emeryville, were also absent from the Oregon midden.

Anatidae.—Geese and ducks were extremely rare among the nine thousand bones from the Oregon site. They made up more than two-thirds of the collection from the Emeryville mound, however; and likewise in the Washington collection they are the most abundantly represented family (61%).

Goose bones are few, but the salt-water and estuarine ducks are in great abundance. The scoters, Canvasback, scaup, Bufflehead, and Mallard all appear. What others may be represented in the great mass of fragmentary duck bones, I feel it unwise to state. The scoters and the Mallard, however, stand out prominently. Jewett *et al.* (1953) mention all these and others as wintering on the Sound in numbers. As a Pleistocene fossil, the Mallard (*Anas platyrhynchos*) is one of the most abundant and widely distributed of ducks. Today it is likewise almost ubiquitous and highly adaptable to varied conditions, including the artificial environment of the barnyard. I look upon it with great respect, as a natural species at the height of its vigor and plasticity.

Cathartidae.—Representatives of this family are conspicuous by their total

absence—much to my disappointment. They were abundant and surprisingly diverse in the Oregon midden, and well represented in the mound at Emeryville. A single condor bone (*Gymnogyps californianus*) was identified from an Indian midden near Coos Bay in southern Oregon (Miller, 1942). The Turkey Vulture (*Cathartes aura*) is a common scavenger about the beaches and estuaries of southern California while the late Pleistocene gravels and asphalts of coastwise California have yielded abundant and varied remains of condors and smaller vultures. They are conspicuous birds in life, and their large quills would make strong appeal to the Indian mind, one would think. How are we to account for their absence from Puget Sound middens? During conversations with colleagues it was suggested to me that cathartids were rare because they find less favorable conditions for their characteristic and essential soaring flight in the coastwise airs, than they do farther inland where rising thermal currents are more frequently available. Such may be the case, but that factor is not so important as to eliminate the group from the fauna of beach, marsh and estuary. Jewett *et al.* (1953) cite many records of condors observed by early travelers to the coastal area, from the mouth of the Columbia River to Ft. Vancouver and into British Columbia at Burrard Inlet. The Turkey Vulture is recorded as breeding at Bellingham, Washington, and in British Columbia. It would seem then that cathartids are, or have been, well known in coastwise Washington within the historical period, and were surely present at the time these Indian middens were being accumulated.

In the paper on the Oregon midden (Miller, 1957) some discussion was ventured concerning the ceremonial usage of condors, eagles, and ravens by Indians of various tribes, and it was suggested that the great abundance of condor and eagle bones in that mound was due to ritual usage. That impression has grown even stronger in my thinking with the passing of time. It is readily conceded, however, that a custom widely spread throughout Oregon, California, and Arizona might have been totally foreign to the ritual of Puget Sound tribes. Mr. Eugene Christman, in conversation, suggested that these large birds may even have been taboo as sacred deities not to be touched by human hands. Again, their remains, if such came to hand, might have been burned or buried in special and remote places. Some such explanation seems more plausible than that these striking species were not present, or were of no interest to a primitive people living as a natural element in the general biota of the area.

Accipitridae.—Even more conspicuous than the cathartids and probably much more abundant along the coasts and estuaries, would be the Bald Eagle (*Haliaeetus leucocephalus*), an inveterate fisherman and beachcomber, not to say pirate. Furthermore, eagles have seemingly appealed to men of all times and tongues. Why not to the Indians? They must have been an im-

portant element in the Puget Sound biota of pre-Columbian times, but only five bones were found in the Washington midden. The eagle is the second most important element in the fauna of the Oregon midden.

The genus *Buteo* is represented by a single bone fragment that is not distinguishable from *B. jamaicensis*. None of the smaller hawks, falcons or the Osprey appears in the collection.

Tetraonidae.—Only two bones of this family are found in the collection, a complete ulna and, strange to say, an almost perfect furcula. Why this fragile "wishbone" should have been preserved when more rugged bones are fragmented is an unsolved question. Likewise, problematic is the small number of bones. They are not distinguishable from the Blue Grouse (*Dendragapus obscurus*), a species that is abundant throughout the state "from sea level to timberline." Its behavior often borders on a state of "stupidity" giving it the widely applied name of fool-hen. My own experience with it would suggest that no great skill or craftiness on the part of a primitive hunter would be necessary to add this acceptable item to his menu on frequent occasions. Were the Indians so well supplied with maritime food species within the immediate vicinity that they made no short forays into the freshwater brushlands adjacent to camp? The presence of abundant ungulate bones would oppose such suggestion.

Gruidae.—An imperfect coracoid and the distal condyles of a right tibiotarsus represent a crane somewhat larger than the average of the race *Grus canadensis canadensis*. Cranes were lacking in the Oregon midden but were fairly well represented in the Emeryville mound.

There are no rail or coot bones. The widely ranging and abundant American Coot (*Fulica americana*), though preferring fresh water during the nesting season, is not uncommon in winter on sea coasts and estuaries. I was surprised not to find it in the Puget Sound collection.

Laridae.—In view of the tremendous number of gull bones recovered from the Oregon midden it is surprising to find that they are so rare in the Washington collection. The Oregon midden is located on the south bank of the Columbia River east of the Cascade Range. There is no quiet water there at present and no extensive beach, although there is some indication of a small diverticulum of perhaps intermittent nature that once provided quiet water at certain seasons. The Washington middens lie at the mouth of Puget Sound practically at tide level where gulls should be extremely abundant. Since marine shells make up the major part of the midden refuse, perhaps we might conclude that gulls were not tempting to the Indian appetite. Still, loons and grebes are of frequent occurrence, though possibly these were brought into camp for their densely feathered skins to be used as "raincoats."

Alcidae.—The auks and murres are even less abundant than the gulls, and

all bones are from mature birds. Seemingly there were no nesting colonies nearby.

Scolopacidae.—A single bone represents the great group of the shore birds.

Strigidae.—The owls are represented by a single bone of the Great Horned Owl (*Bubo virginianus*). The immediate environment was probably not attractive to the owls, nor would their flesh strongly attract the Indian except perhaps as "medicine." The bones of large ungulates and bear, however, indicate that the Indians hunted farther afield. Numerous petroglyphs on rocks near the Oregon site indicate an awareness of owls. Probably a superstitious fear made the Indian avoid close contact with these birds.

Corvidae.—Two bones of a crow not distinguishable from *Corvus caurinus* are the only representatives of the passeriform birds. Jewett *et al.* (1953) state, "Great numbers of Northwestern Crows are to be observed along the ocean beaches, the Strait of Juan de Fuca, and in the Sound region." They become almost domestic at times so must have been frequent camp "hangers-on" of the midden sites. Despite an uncanny ability to take care of themselves they must have been occasionally available had the Indians cared to make use of bodies or feathers. Like the owls, they must have been shielded by Indian psychology.

This paper represents a study of bird remains actually in hand—a study made by an ornithologist interested in living, active, flying creatures grouped into a fauna that had developed through the years in response to a set of environmental factors held in delicate balance by variable forces, any one of which may be responsible through its own variability for an imbalance that could distort the whole picture. A primitive race of the natural species *Homo sapiens* had been for some thousands of years an element in the ecologic environment at the Puget Sound site. Did he exert a pressure of some magnitude? I doubt it. He was not a planter, not a herdsman, not a destroyer of the landscape by fire, by cutting or trampling of large areas. He was a simple fisherman and hunter of limited prowess. The picture he painted on the sands of his own "kitchen midden floor" is frustratingly incomplete. Yet some of its lines are fascinating.

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GENERAL NOTES

Anting of a captive Slate-colored Junco.—Although the peculiar behavior by which birds apply ants to their plumages is now well known through several excellent reviews (e.g., Ivor, 1956. *Nat. Geog.*, 110:105–119; Whitaker, 1957. *Wilson Bull.*, 69: 195–262), no actual description of "anting" by the Slate-colored Junco (*Junco hyemalis*) appears to have been published. On March 27, 1958, I observed one of my captive juncos anting, apparently with sawdust. I released the bird in a small empty room in the Harvard Biological Laboratories (Cambridge, Massachusetts) as part of a series of experiments on emberizine behavior. I watched the bird through an observation window as it explored the floor, which was covered with a layer of sawdust and wood shavings. As I was about to introduce another junco into the experimental room, the first individual began performing motions which I realized were those of anting.

The junco stood on the floor with legs rather spread, in contrast to its usual stance. It pecked several times into the sawdust, and then began quickly stroking the undersides of its primaries with its bill. Because I had not recognized the anting immediately, I did not note the sequence or exact morphology of these first motions. The bird pecked once more into the shavings and again touched the underwings and the flanks with something in its bill. Again, the motions were of a stroking type, as opposed to dabbing movements. The wings were spread only slightly while their distal ventral surfaces were stroked, and the tail was not touched. There was no tripping or other tumbling-like motion. The junco anted for about a minute and a half, after which it began hopping around the floor, continuing to investigate its new environment.

Because it was not possible to distinguish what had been in the bird's bill at the time of anting, I subsequently examined quite carefully the general area in which the bird had been standing and found nothing other than the wood shavings and dust. It is possible that a single ant or beetle was found and utilized by the junco, but I could find no evidence of it. Other juncos released in the room did not ant, and in subsequent experiments the bird referred to above never did so again.

Anting by the Slate-colored Junco was reported to occur by Ivor (1941. *Auk*, 58:416), and later mentioned by Ivor (1943. *Auk*, 60:54) and Bagg (1952. *Jour. Mamm.*, 33:243), but neither author gave a description of the behavior. Whitaker (*op. cit.*, 232) indicates that at least ten New World emberizine species are known to ant, and, as was stated above, the behavior in one form or another is widespread among birds.

The anting reported here was the "active" type, where the bird picks up material to rub on its plumage, as opposed to the "passive" type where ants are allowed to crawl over the bird (Whitaker, *op. cit.*). The motions used were of a stroking nature, differing from the dabbing motions of Whitaker's captive Orchard Oriole (*Icterus spurius*), but apparently similar to movements used by other species (Whitaker, *op. cit.*, 208). The tail area, usually a primary target of anting, was ignored by my junco. This fact, along with the short duration of the observation, and the lack of tumbling and extreme posturing, suggest that anting was of quite low intensity.

The purpose of anting has long been questioned by observers. Several authors have attempted to link anting with feeding, plumage care, or parasite removal, and Whitaker (*op. cit.*, 195) lists many other explanations which have been proposed. My junco neither fed nor preened after anting, nor was it visibly infested with ectoparasites (I examined the bird in the hand several times). The latest theory is probably that of Whitaker, who presents good evidence that ants (or substitutes) utilized give off a burning or "thermogenic" stimulus to the bird which is pleasurable to it in some manner. I have seen no record of sawdust being used by birds, nor does Whitaker mention its

use by any species. If the junco did use sawdust, and not just a passing isolated insect, it is interesting to suggest what possible thermogenic properties sawdust contains; or, if it is not thermogenic, what provoked the junco to ant with it. Whitaker (in letter) has speculated that the sawdust may have been treated with a burning stimulant, or might have contained tannic acid. Unfortunately, no analysis of the material was made at the time.

In her review, Whitaker (*op. cit.*, 237 ff.) devotes considerable space to a discussion of the type of stimulus the bird receives, and the "object" of anting. Her principal suggestion is that some kind of sexual stimulation may be derived from applying thermogenic material to the area of the vent, and this explains some of the display-like motions which often accompany anting. My junco gave no indications of performing any of the known sexual displays of the junco (Sabine, 1952. *Auk*, 69:313–314), and the bird's apparent lack of the usual overt expression of some kind of "pleasure" may have been due to the low intensity of the anting bout.

I am grateful to Professor E. O. Wilson and to W. J. Bock for making the experimental room available. I am especially indebted to Mrs. Lovie M. Whitaker for reading the original version of this note and supplying many interesting suggestions about the subject of anting.—JACK P. HAILMAN, *4401 Gladwyne Drive, Bethesda, Maryland, August 17, 1959.*

Notes on feeding and fecal-sac disposal of sapsuckers.—On July 10, 1959, I observed a pair of Yellow-bellied ("Red-naped") Sapsuckers (*Sphyrapicus varius*) nesting in a grove of aspen at Grayling Creek, near West Yellowstone, Montana. Some aspects of their feeding behavior and their disposal of fecal sacs seem worth recording. Just 48 feet north of the nest tree, and facing it, was a dead bracket fungus on a tree trunk, about 16 feet from the ground. This fungus was used as a sort of "work-shelf" by the sapsuckers. To it they brought insects (mostly salmon-flies, Plecoptera) to be pounded before being fed to the young birds. Sometimes they flew directly to the nest and fed to the young the insects held in the forepart of their bills, then flew back to the fungus shelf to pound the remaining insects to the right consistency for feeding. Both parents used the shelf in this manner. One bird always flew north and east to catch insects, flycatcher-fashion, over Grayling Creek; the other always flew south.

Insects were sometimes left on the shelf to be collected later. One bird brought an oblong white object about an inch and a half long and placed it on the shelf, picked at it a couple of times, then flew away, leaving the object behind. After long study with binoculars, I could make nothing of it but a reptile egg, although I know of no turtles or egg-laying snakes in this area. The object was left on the shelf through several feedings of the young. I left the vicinity of the nest for about 45 minutes to get a ladder, but when I returned the object was gone.

When a fecal sac was removed from the nest (always done by the male), it was carried to the same fungus shelf. Here the sac itself was eaten by the bird, the fecal contents dropping to the ground. The area immediately below the shelf was well littered with excrement, some adhering to the edge of the shelf and to the tree below the shelf. During my period of observation no sacs were carried away from the nest and simply dropped as is the habit of many birds. The fecal sacs of all other birds I have watched are opaque, while that of the sapsucker is transparent.

I have watched sapsuckers use a common insect-killing and "sewage disposal" place at two other Montana localities, Upper Red Rock Lake and Madison River Canyon, in other years. In both cases these were farther away from the nest tree.—MARY WIBLE, *Carter Camp, Pennsylvania, September 16, 1959.*

Aves incendiaria.—No serious ornithologist today questions the fact that birds ant. Anting with ants or other agents having aromatic or "thermogenic" properties has been demonstrated; or anting within sight of such susbtances; or within sight of objects which directly have nothing to do with the "heat" stimulus, per se, but which have been associated with the production of heat by conditioning (Lovie M. Whitaker, 1957. *Wilson Bull.*, 69:195–262; Maurice Burton, 1959. "Phoenix Re-born"; and others).

Novel, however, is the concept that anting birds may be instrumental in the spread of fire.

In his fascinating book, "Phoenix Re-born," Burton leaves no doubt as to the capabilities of birds as firebugs. At times his tame Rook (*Corvus frugilegus*), Niger, could not resist "disporting itself on a heap of burning straw"—much like the Phoenix of legendary fame—and, still more incredible, would take to casting burning straw about the aviary, ant on an isolated ember and *fan it into flames* with its wings, igniting combustible material near by! Neglected embers would die out.

Playing with fire is not confined to aviary birds alone. Burton cites several instances where wild birds have been suspect—by carrying glowing cigarette ends or other burning substances to their nests and setting them afire. An officer of the Guilford Fire Brigade actually saw a nest smouldering in a tree. Burton himself has observed birds anting on the wing over heath fires and states that it is common to see all kinds of birds flocking at the edge of bush-fires, ostensibly to harvest the fleeing insects.

The startling fact is that Old World corvids have been incriminated since ancient times. Says Burton (*op. cit.*, p. 89):

> There are a number of stories in the ancient books from Roman times down to the seventeenth century, of birds seen carrying glowing embers in their bills and alighting on thatched roofs, setting them afire. There is nothing in these stories to tell us whether the birds anted with the embers once they landed on the roofs. It was, however, sufficiently commonplace for jackdaws, magpies, choughs and crows—all close relatives of the rook—to carry embers in this way for them to be spoken of as *aves incendiaria*.

Are New World corvids so very different from their overseas cousins? There is reason to believe that they are not, though this is conjectural and based upon the flimsiest evidence. At this point of unenlightenment, it would seem short-sighted to exclude *any* bird from the incendiary tag.

Whitaker (*op. cit.*, citing F. W. Miller, 1952. *Auk*, 69:87–88; and *Anon.*, 1952. *Life*, Dec. 8, p. 186 [Photo]) mentions two instances, unrelated, of a captive Blue Jay (*Cyanocitta cristata*) being drawn to lighted cigarettes; one bird anted with them, the other merely held them in its bill. H. Roy Ivor (1958. *Wilson Bull.*, 70:288) discusses his tame Steller's Jay's (*C. stelleri*) predilection for anting with the "hot carbonized end" of a blown-out match and for snatching a lighted cigarette from the mouth of a visitor, subsequently tearing it to bits.

As for definite records of bird-caused fires, there are next to none for the United States. Burton cites (*op. cit.*, pp. 104–106) two reports from the American journal *Fire Engineering* in which birds are strongly implicated. One entry, for April 1954, is entitled "Squirrel smoking in bed?" and concerns a fire which took place in Central Park, New York City. Smoke was found issuing from a hole 25 feet up in a 50-foot sycamore and the flames were duly extinguished. No mention is made of anyone's having *seen* a squirrel, nor is a bird suggested as the culprit. As Burton explains, "It is one of the unfortunate features of these entries in fire-brigade journals that they are laconic in the extreme." In other words, it is not customary to associate birds with fire-spreading.

The other entry, dated June 1954, is about an owl—"Out Beloit, Kansas way"—who inadvertently set fire to some 700 acres of pasture. Wings aflame, it had been forced

to leave the burning tree in which it had been nesting; as it touched upon farmland, the blaze spread. Burton theorizes about the origin of the fire: perhaps some other bird had been performing like a Phoenix in the owl tree and raised a conflagration which caught the owl unawares as it dozed in a hollow.

Less speculative is Burton's reference (*op. cit.*, p. 107) to a newsclipping from the *Courier–Journal* of Louisville, Kentucky, for January 14, 1958. Fire Chief Kenneth Reeve of Franklin placed the blame directly on a bird. To quote from the account: "He said there simply was no other way the fire, which caused very little damage, could have started in a downtown building. He reported a sparrow must have picked up a lighted cigarette and carried it to a nest in the eave of the structure . . ."

Most convincing is this communication from Ann Arbor, Michigan. My father, A. D. Moore (letter, Dec. 27, 1959) wrote after an interview with Harold Gauss of the Ann Arbor Fire Department:

I stopped Harold and said I had a serious question. What about birds starting fires? The answer was immediate and positive. Of course they do. Incident: in 1925, the Old Methodist Church had a roof fire. Harold remembers it clearly, for water pressure was often low in those days. When he climbed the ladder with the hose, and got within a few feet of the fire, no water came. He held the hose vertical, looked down the hole, and saw the water, doing its best, but stopped a yard or so down from the nozzle. When the pumper was started, he got water. The ridge row of the roof had collected a lot of nests, sparrow and pigeon, as he remembers it. The nests were afire.

Harold says they have had to put out nest fires more than once on top of the Allenel Hotel; and more than once on another downtown building he named.

It must be emphasized that two facts are inescapable: (1) some birds ant with or near smouldering substances or flames; (2) certain fires have been traced to birds. The implications are tremendous. To what degree are birds responsible for sprouting and spreading fires under tinder-dry conditions? Those crows and ravens along the road . . . could they be interested in cigarette butts as well as carrion? Those fires which start unaccountably on roof tops, in isolated trees or palms, on the side of a billboard . . . could an ember-carrying sparrow be to blame? Those jays hopping about the picnic tables . . . could a dying campfire, unattended, be far more irresistible than the tidbits?

It is obvious that a fund of information is needed to fill out the story of *aves incendiaria* and their kind in the Western Hemisphere. I would welcome any observations to this end.—Jeanne Moore Goodman, *Cedar Crest Cabin, Fallsvale (east of Redlands), California, March 31, 1960.*

Marsh Hawk breeding in northwestern Arkansas.—Nesting records of the Marsh Hawk (*Circus cyaneus*) are sparse for the state of Arkansas. Baerg in his "Birds of Arkansas" (1951. *Univ. of Ark. Col. of Ag. Bull.* no. 258:52) states that the Marsh Hawk nests uncommonly in the northwestern section of the state. Bent (1937. *U.S. Nat. Mus. Bull.* no. 167:92) excludes Arkansas as a part of the breeding range for this species. The 5th edition of the A.O.U. Check-List (1957:115) does likewise.

On April 13, 1954, I discovered a solitary Marsh Hawk nest (no eggs) quite accidentally while on a field trip within the confines of Fort Chaffee Military Reservation, 8 miles south of Fort Smith, Arkansas. The nest site was located in a remote locality 2 miles west of the camp proper. This area was formerly a firing range for military training.

The nest was situated on dry ground at the base of a 5-foot persimmon tree about 500 yards from a well-traveled gravel road. The nest was surrounded by lush vegetation, which included pubescent paspulum (*Paspalum pubescens*), persimmon (*Diospyros*

TABLE 1
INCUBATION PERIOD OF THE MARSH HAWK

Egg numbers	Date laid	Date hatched
1	April 14	May 6
2	April 16	May 8
3	April 17	May 9
4	April 20	May 13
5	April 22	May 14
6	April 23	May 16

virginiana), sassafras (*Sassafras albidum*), and patches of running blackberries. A natural spring occurred about 300 yards east of the nest site.

The nest cover was composed largely of dead arrow grass (*Aristida purpurascens*). A few small twigs surrounded the exterior of the nest, which was about 20 inches in over-all diameter.

From April 13 to May 19, 1954, I made daily trips to the nest site, a total of 40 trips and 196 man-hours. By April 23, six eggs had been laid (Table 1). Incubation period of the last egg lasted 24 days. Only the female incubated during the period of study.

Between April 14 and May 15, I obtained food data from 63 pellets regurgitated by the adult and young (Table 2). I collected the pellets within a few feet of the nest.

TABLE 2
PELLET ANALYSIS OF THE MARSH HAWK

	No. pellets containing remains
Reptiles	
Plains garter snake (*Thamnophis radix*)	14
Unidentified snakes	7
Amphibians	
Leopard frog (*Rana pipiens*)	3
Unidentified amphibians	1
Birds	
Redwinged Blackbird (young) (*Agelaius phoeniceus*)	16
Unidentified passerines	2
Others	
Crayfish (*Cambarus diogenes*)	11
Eastern cottontail (*Sylvilagus floridanus*)	9
Total	63

Table 2 shows that snakes and young Redwinged Blackbirds, prolific and widespread forms, were the primary food items. An interesting food item was the crayfish, which ranked third in frequency. Young cottontail rabbits also ranked high as a food item.

On May 20, 1954, the Marsh Hawk nest was found to be completely destroyed, with no trace of the six young. The cause was unknown, but it is my belief that man was involved since well-traveled roads nearly surrounded the nest site.—EUGENE J. WILHELM, JR., *Dept. of Geography & Anthropology, Louisiana State University, Baton Rouge, Louisiana, September 24, 1959.*

Behavior of birds on warm surfaces.—It is well known that certain parallelisms of posture and movement may occur in the sunning, bathing, dusting, and anting activities of birds. Recent evidence that the sensation of heat can be a common factor supports the view that these are not separate and distinct habits but a behavioral complex. With exact relationships and motivations yet to be determined, any activity in which elements of these behaviorisms are associated with heat should be of interest. See Conway (1959. *Wilson Bull.*, 71:188–189) and sources therein.

On July 15, 1957, at 1:05 p.m., I startled two adult Arkansas Kingbirds (*Tyrannus verticalis*) from a fallow flower bed at the University of Oklahoma Infirmary. One bird returned immediately and spread itself out flat, neck extended with bill nearly touching the sunny ground, the full-spread wings and flared tail pressed upon it. For a minute or two the bird remained motionless. Its ventral plumage was hidden from view, but I noted with interest that the dorsal plumage was not raised, not even the pileum. Soon the bird lifted its breast and, in a low squat, made two hurried preening strokes along the outer primaries of one wing, before resuming the spread-eagle pose. Banging of a door caused it to fly.

At once I examined the bed, marking the place used. The hard-baked earth bore no sign of mulch, manure, animal life, or of dust-bathing. Moments later, Mr. Ralph E. Reed, staff pharmacist, using a Nitrogen-filled Incubating Thermometer on that spot, obtained a reading of 60° C. (140° F.). Air temperature was 95° F. at the local weather station.

Fifteen minutes later and 60 yards distant, two kingbirds preened in full sunlight on the limb of a tree.

A related incident occurred on a concrete court, centered with a pedestal bath that was frequented by two grown but still dark-eyed Brown Thrashers (*Toxostoma rufum*). At 11:45 a.m., on July 28, 1959, I noticed one of these birds, alone on the court, behaving strangely.

The thrasher squatted, breast and tail on the concrete, wings slightly drooped, head and body feathers lifted. Incipient bathing? But the bath was unoccupied and the court entirely dry. Soon the bird began to run about in short spurts, rodent fashion, with belly close to the substrate, wings lax, contours fluffed. Between runs, it performed movements suggestive of low-intensity dusting or bathing, but did not duck the head. Whenever it paused, the ventral plumage obviously was so spread that the apteria must have been close to, if not touching, the concrete. Moving on a wide circle, the bird chanced into the shadow of the bathing bowl. Instantly it assumed sleek posture, looked about, then ran on out into the sunny area, where it just as automatically puffed itself up and resumed the run–"bathe"–run sequence. It had come nearly full circle when two House Sparrows (*Passer domesticus*) alighted on the court. The thrasher started toward them, now running normally, veered, and disappeared among some shrubs.

This bird, or its sibling, again was on the court 30 minutes later, behaving in the same manner. At no time during these events did the thrasher hold out its wings, though whenever it "bathed" their edges brushed the flooring, and the tail was spread. The court, clean-washed from the previous day's rain, was too hot for comfort, as tested with the palm of the hand, while the shadowed area was relatively cool. The weather was humid, with a reported temperature of 86° F. at 11:30 that morning.

Five days earlier, in bright sun at 9:30 a.m., an immature, hand-raised Blue Jay (*Cyanocitta cristata*), then free-living, flew to an iron clothesline post, expecting to be fed. It took food from my hand and, spreading the wings laterally on the cross-arm, almost instantly assumed the sunning position shown for the species by Hauser (1957.

Ibid., 69:86, Fig. 1). Thus it remained for nearly two minutes, food in bill, before departing. The metal was quite warm.

The role of strong light relative to warm surface is by no means clear in these cases, yet it seemed to me that kingbird, thrasher, and jay all were reacting mainly to the unusually warm surfaces. One wonders whether the behavior of immature Bank Swallows (*Riparia riparia*) that congregated by the thousands on pavement of a "6,000-car parking lot" in Michigan, during late hours of a July morning, may have been triggered by a high surface temperature, possible under the conditions stated (Crockett and Nickell, 1955. *Jack-Pine Warbler*, 33:86). These birds "appeared to be displaying incipient mating, nest building, and brooding behavior." Similarly suggestive is an account of immature "barn swallows" on Fire Island, N.Y., "at play" in early fall (Booth, 1932. *Nature Magazine*, 20:21–22). For about 30 minutes some 40 birds jostled to launch themselves down the face of a sand dune on their "stomachs," not flying but using wings "as if they were oars." Ascent was made by "flapping and pushing their wings in the sand in the funniest manner." Their odd tracks extended the height of the slope. Chill of weather and warmth of sand were seen as factors in this activity, in which "parent birds" took no part.—Lovie M. Whitaker, *1204 West Brooks Street, Norman, Oklahoma, January 18, 1960.*

Bell's Vireo in New Jersey.—On September 15, 1959, during the Operation Recovery bird-banding program at Island Beach, New Jersey, Mr. and Mrs. Albert Schnitzer of Mountainside, N.J., trapped in a mist net a small, brown-eyed vireo unfamiliar to them. They brought the bird to banding headquarters where it was identified as a Bell's Vireo (*Vireo bellii*). Recognizing that the presence of this species in New Jersey had never been verified, I collected the bird with their approval. It was a female with skull not ossified; it weighed 10.2 grams; it was in little-fat condition; and the largest ovum was less than 1 mm. I have compared the specimen with reference material in the American Museum of Natural History collection and identified it as a representative of the Midwestern race *V. b. bellii*. Subspecific determination was confirmed by Eugene Eisenmann.

Although this species has been reported previously from New Jersey (Fables, 1955. Ann. List of New Jersey Birds, p. 75) and from the New York City region (Cruickshank, 1942. Birds Around New York City, *Amer. Mus. of Nat. Hist. Handbook Series* No. 13:364), both of these writers have rightly considered the species as "hypothetical," pointing out the possibility of confusion with immatures of *V. griseus*. I am unable to find any undoubted recent records for the east coast. Apparently the only other specimen from east of the Appalachians was taken by Ned Dearborn in Durham, New Hampshire, on the extraordinary date of November 11, 1897 (Brewster, 1901. *Auk*, 18:274).

I am indebted to the late Dr. F. C. Lincoln for making data on previous records available to me.—Joseph R. Jehl, Jr., *385 Grove Street, Clifton, New Jersey, October 23, 1959.*

American Coot successfully escapes from a Bald Eagle.—On March 20, 1955, I was overlooking a portion of the Mannington marshes northeast of the city of Salem, New Jersey. Almost 6 inches of snow had fallen during the night but the morning was clear. A mixed flock of ducks including Pintail, Baldpate, Black, Green-winged Teal and a few Mallard were feeding along the edge of open water extending from the road about 30 yards to the north where marshy vegetation began and continuing for another 50 yards to higher ground with a border of shrubbery and small trees. In the open water was a flock of about 50 Coots (*Fulica americana*). I had finished scanning the

flock of ducks when I noticed that they suddenly became alert; a moment later they took flight almost as one bird. Simultaneously, the Coots scurried together and began "running" and swimming toward a culvert under the road connecting two sections of the marsh. Just then, I noticed an adult Bald Eagle (*Haliaeetus leucocephalus*) coming across the road, not very high and moving very fast. It made a quick pass at a lone Coot which had become separated from the flock and was at the moment of the strike behind a loose screen of low vegetation. By dodging behind an old mallow plant in which the Eagle was momentarily entangled, the Coot escaped this strike. Without attempting to gain altitude the Eagle made a second strike at the Coot, now in the open but in shallow water. This time the Coot waited until the last second, submerged and almost instantly popped to the surface like a cork. The Eagle of course had been carried by its momentum some distance past the Coot swimming toward the safety of the culvert but not in any apparent hurry. The Eagle now circled until it reached an altitude of perhaps 20 feet whence, after several false starts, it made a third pass at its intended prey. After two more futile strikes, the Eagle gave up and flew away, although the Coot was still some distance from the safety of the culvert. The technique of a well-timed submersion and an immediate resurfacing, which did not seem to require great physical exertion, appeared to be one which could have been continued for a long time.

This is the second time that I have seen Coots use under-road culverts as a refuge from an attacking eagle. As an incidental note, the flock scurrying for the culvert kicked up some spray while "running." I saw nothing resembling the splashing defense described in the literature.—R. O. Bender, *Cobb's Mill Road, R.D. No. 1, Bridgeton, New Jersey, October 1, 1959.*

The Fish Crow in easternmost Oklahoma.—Since the 4th edition of the A.O.U. Check-List (1931) the known breeding range of the Fish Crow (*Corvus ossifragus*) has been extended north and west in Arkansas, and west into east-central Oklahoma. Bent (1946. *U.S. Nat. Mus. Bull.* no. 191:282) only mentions this species as occurring in central Arkansas near Little Rock. Baerg states in his "Birds of Arkansas" (1951. *Univ. of Ark. Col. of As. Bull.* no. 258:107) that the Fish Crow is found in the vicinity of Van Buren, Crawford County, throughout the year, and in other areas farther south. The species has also been reported from Fort Smith, and this fact is mentioned in the 5th edition of the A.O.U. Check-List (1957).

In January, 1954, I saw six Fish Crows feeding on dead fish along the south embankment of the Arkansas River, about 8 miles west of Moffett, Oklahoma. Later in the month I discovered a small roost of about 800 crows on an island in the Arkansas River about 18 miles west of Moffett, this number including 33 Fish Crows. Tall willows (35–40 feet) were utilized in roosting, but the *ossifragus* remained apart from the Common Crows (*Corvus brachyrhynchos*), occupying the extreme end of the roost. On April 20, 1954, I found a Fish Crow's nest 8 miles west of Moffett, Oklahoma. The nest was situated about 30 feet above the ground in a red oak. Examination revealed four eggs. The last visit I made to the nest site (May 1) showed no change.

The partiality of the Fish Crow to major water bodies is exemplified by these observations, all of which were made near the Arkansas River. It would not be surprising to discover the Fish Crow farther up this river, where it may have been overlooked.—Eugene J. Wilhelm, Jr., *Dept. of Geography & Anthropology, Louisiana State University, Baton Rouge, September 24, 1959.*

Birds breeding at Cap des Rosiers, Québec.—The easternmost point along the north coast of the Gaspé Peninsula, Province of Québec, is an area of rocky headlands, coniferous forests, and wave-washed cliffs projecting out into the Gulf of St. Lawrence. Three miles short of Cap Gaspé, the extreme tip of the peninsula, the cliffs of Cap des Rosiers rise up 900 feet above the sea. Here are found many breeding birds of both land and sea. Much has been written of the Gannets (*Morus bassanus*), Black-legged Kittiwakes (*Rissa tridactyla*), Common Puffins (*Fratercula arctica*), and others of Bonaventure Island and Percé, some 23 miles southward; the birds of the Cap des Rosiers area are equally interesting. I observed them while encamped there from August 5–7, 1959.

Dense forests, mainly white spruce and balsam fir, extend to the edge of the cliffs. Mountain maple and white birch are present in small numbers, and there are a few cleared spots of grassy meadows. Alders fringe the margins of the cliffs. Mountain ash, bunchberry, and fireweed were in full color. Breeding land birds of this area, accompanied by fledglings, included the Eastern Wood Pewee (*Contopus virens*), Magnolia Warbler (*Dendroica magnolia*), American Redstart (*Setophaga ruticilla*), Pine Grosbeak (*Pinicola enucleator*), American Goldfinch (*Spinus tristis*), Slate-colored Junco (*Junco hyemalis*), and White-throated Sparrow (*Zonotrichia albicollis*). Several broods of some of these were present. Also observed in the vicinity, and doubtless breeding here, were the Yellow-shafted Flicker (*Colaptes auratus*), Hairy Woodpecker (*Dendrocopos villosus*), Gray Jay (*Perisoreus canadensis*), Black-capped Chickadee (*Parus atricapillus*), White-breasted Nuthatch (*Sitta carolinensis*), Robin (*Turdus migratorius*), Golden-crowned Kinglet (*Regulus satrapa*), Solitary Vireo (*Vireo solitarius*), and Pine Siskin (*Spinus pinus*). The Veery (*Hylocichla fuscescens*) and Common Redpoll (*Acanthis flammea*) were also seen.

The higher cliffs, probably pre-Pleistocene in age, are separated from those below by a plateau several hundred yards in width sloping down to the sea. The lower cliffs, of sandstone formation, attain a maximum height of about 190 feet. On narrow ledges and in crannies of these lower cliffs, for a distance of nearly half a mile and at all elevations from the high tide line to the summit, were breeding colonies of sea birds. Most of the young had hatched, and many were flying or attempting to do so. Species noted here are listed below.

Double-crested Cormorant (*Phalacrocorax auritus*).—About 50 pairs were seen about the cliffs, nesting in small groups high up on the rocks. Some young were out of the nest, but many remained and were being fed on fish. The adults, diving from the surface, caught most fish well inshore. After repeated dives they returned to the ledges to dry out. An interesting trait in their flight behavior was evident one morning when most of the cormorants were on the rocks, in bright sunlight. Two of them, from different sections of the cliffs, launched themselves at one time into the air, circled independently several times over the water, flew back and forth for about three minutes before the cliffs, and then returned to their original sites. Almost at once, in rotation, two more birds took off and repeated this procedure. It was as though two roving sentinels patrolled the area while the others relaxed.

Herring Gull (*Larus argentatus*).—This species nests at many localities in the Gaspé; several hundred were present on the cliffs at Cap des Rosiers, perched at all elevations on the rocks. Most of the young were flying. Fish were caught, well beyond the line of breaking surf, by diving from considerable heights. An adult, resting on the rocks, was once disturbed by a young murre which stumbled into its immediate area. The intruder was seized by the head and shaken vigorously, then was carried off, still strug-

gling weakly, and dropped into the deeper water to drown. The gull remained on the surface near by for a few minutes until the murre sank from sight, not to reappear.

Razorbill (*Alca torda*).—A dozen or so, some of them immature, were seen on the rocks, closely associated with gulls or cormorants, or swimming with stubby tails upturned and diving for food nearby. Apparently the young were all out of the "nest" by this time.

Common Murre (*Uria aalge*).—A score or more of these sharp-billed alcids were clustered in several groups low on the rocks; others dived or rested on the water. Most of the young were fledged. One, smaller than the rest, had either fallen from its natal crevice or was making its initial descent to the sea. A breaking wave, higher than most, buffeted it about on the rocks and then washed it out to deep water. It struggled ineffectually for a minute or more, and then another wave cast it up on the rocks again, where it secured a foothold.

Black Guillemot (*Cepphus grylle*).—The small "sea pigeons," jet b'ack with pure white wing patches, nest apart from other species in the deep rocky fissures, rather high up. The young were all in flight, but dozens were on the water or fluttering with swift wing-beats over the surface. They fish well inshore, often beneath the breaking surf. One was observed while feeding, ducking suddenly under the water and swimming, like the other alcids, with its wings. During the course of 15 dives, it stayed submerged on the average for 23 seconds, and rested on the surface for 20 seconds between dives.

From time to time other species mingle with the colonies of breeding sea birds, but usually in small numbers and briefly. Observed among these birds at Cap des Rosiers were the Great Black-backed Gull (*Larus marinus*), Kittiwake, Common Tern (*Sterna hirundo*), Common Raven (*Corvus corax*), Common Crow (*Corvus brachyrhynchos*), and Gannet. No intolerance was noted between these intruders and the resident population. —Richard H. Manville, *U.S. Fish and Wildlife Service, Washington 25, D.C., September 28, 1959.*

A fatal and a near-fatal strangling accident of small birds.—On May 7, 1959, on the Madison River bank near West Yellowstone, Montana, I found an adult female Audubon's Warbler (*Dendroica auduboni*) strangled by a horse hair. The hair, 25 inches in length, was caught in the tall marsh grass by one end, with the other end free. The warbler, which was still warm when found, was apparently a nesting bird. All eggs had been laid and only two very small yolks were visible in the ovary. The specimen, preserved as a mummy with the horse hair intact, is now in the collection of Carnegie Museum, Pittsburgh, Pennsylvania.

I witnessed what was almost a similar tragedy at the Bear River Marsh Refuge near Brigham City, Utah, on May 15, 1958, while I was trying to photograph Barn Swallows (*Hirundo rustica*) gathering mud for their nests. As each bird flew to the mud puddle, it plucked, on the wing, a dry grass stem 8 to 12 inches long. Then, with the piece of grass grasped in the center with the bill, it lit, gathered a load of mud, and returned to the nest site. Suddenly, one of the swallows began to struggle frantically. I found that it had become hopelessly entangled in about 10 feet of gut leader discarded by a fisherman. Part of this leader had been trampled into the mud, leaving a number of free loops. The swallow, after gathering its mud nearby, had flown into and had been entrapped by one of these loops. I cut the bird free only minutes before it probably would have strangled to death. When released, it flew to a telephone wire and spent some time preening its ruffled feathers.—Mary Wible, *Carter Camp, Pennsylvania, September 16, 1959.*

Common Grackles anting with moth balls.—On June 27, 1960, at about 5:00 a.m. (CDT), I heard a great chatter of grackles in the front yard. There were about 25 or 30 Common Grackles (*Quiscalus quiscula*), and on the walk were about 10 more with moth balls in their bills. They would rub the moth balls under the wings, along the breast and belly, along the back between the wings, and in the anal area. They would drop the moth balls, shake and shiver, and some would drag themselves along on the walk and in the grass. Those doing this would definitely rub the area of the vent on the walk and in the grass. They would fluff their plumage, and run the bill down the wing quills without the moth ball. Even the young ones took it up, but many of them would fall over. Some rolled in the grass as they tried to rub the moth balls over their feathers. Their antics were so varied it would be hard to describe them all. (See Hill, 1946. *Wilson Bull.*, 58:112; Whitaker, 1957. *Wilson Bull.*, 69:195–262.)

On June 29, 1960, Frank Bellrose and I observed them again anting with the moth balls, this time at about 7:00 p.m.

My observations indicated that the grackles never anted with the moth balls during the middle of the day. They would sometimes pick them up, but never ant with them. The early morning hour and from one to two hours before dusk seemed to be the anting time for them.

On July 10, 1960, one large adult male anted from 4:54 p.m. to 5:23 p.m. He completely and systematically rubbed every feather he could reach on his body, then the wing and tail feathers, with a small moth ball. He knocked over two other adult males who apparently tried to get his moth ball away from him.

I found that I could get the grackles to ant sooner by placing moth flakes in the grass among the moth balls. Apparently the fumes from the flakes made some of the birds' ectoparasites move about, because the birds would immediately start to peck rapidly in first one place, then another, and then ant vigorously with a moth ball.

I observed one young bird chip a part of a moth ball and eat it. Later, I saw an adult bird do the same thing. In both cases, after anting awhile with a moth ball, they both acted like they were very sick. They both walked over by a rose bush and stood with drooping wings and a disinterested attitude. Within an hour they both flew away. On July 20, 1960, grackles were still anting with moth balls.

During my observations I have noted other birds in the area. A Red-headed Woodpecker (*Melanerpes erythrocephalus*) took a moth ball from the ground and flew with it to his nest in a hole in a nearby tree. One Starling (*Sturnus vulgaris*) fluffed his feathers but did not ant. Blue Jays (*Cyanocitta cristata*), young and old, did not ant. Robins (*Turdus migratorius*) did not ant with the moth balls, but I observed an adult male Robin ant over a nest of very large (⅝-inch) brownish-black ants.—Leo H. Borgelt, *219 North Promenade Street, Havana, Illinois, July 22, 1960.*

NEW LIFE MEMBER

Francis L. Jaques, bird artist and illustrator for thirty-five books on birds, mammals, and other outdoor subjects, is a new Life Member of the Wilson Ornithological Society. Mr. Jaques has painted some eighty backgrounds for exhibits in museums including the American Museum of Natural History, the Boston Museum of Science, the Peabody Museum of Yale, the Minnesota Museum of Natural History, the University of Nebraska State Museum, etc. His special interests in ornithology include studies of game and sea birds, and the conservation of their habitats.

Mr. Jaques has been a member of the Society since 1939, and is also a member of the A.O.U., the Linnaean Society of N.Y., and the Explorers' Club.

ORNITHOLOGICAL NEWS

The 1961 annual meeting of the Wilson Ornithological Society will be held at Huntsville, Ontario, Canada, on June 8–11. This will be the first annual meeting of the Society held in Canada.

The Wilson Bulletin now goes to each of the fifty states, the District of Columbia, the Canal Zone, Puerto Rico, the Virgin Islands, and forty foreign countries.

Most back numbers of *The Wilson Bulletin* are available and may be ordered from the Treasurer. Numbers not available from the Society may be obtained as Xerographic enlargements (prints) made from microfilms. For further information write to University Microfilms, Inc., 313 No. First Street, Ann Arbor, Michigan. Prices depend upon size of enlargement desired, and the Society receives a royalty on all such sales.

Awards for ornithological research are made in April of each year by the Frank M. Chapman Memorial Fund Committee of the American Museum of Natural History, New York. Applications should be received by March 1.

The Thirteenth International Ornithological Congress will be held at Cornell University, Ithaca, New York, from June 17 to 21, 1962. The President is Professor Ernst Mayr.

These Congresses are scientific meetings which have been held at intervals since 1884. Since 1926, a four-year cycle has been maintained except for a twelve-year interruption caused by World War II. The previous Congresses have been held in continental Europe and England.

Persons wishing to receive further announcements, and membership application forms for the Congress, should send their names and permanent mailing address to the Secretary-General, Professor C. G. Sibley, Fernow Hall, Cornell University, Ithaca, New York, before February 1, 1961.

The Division of Biological and Medical Sciences of the National Science Foundation announces that the next closing date for receipt of basic research proposals in the Life Sciences is January 15, 1961. Proposals received prior to that date will be reviewed at the spring meetings of the Foundation's advisory panels and disposition will be made approximately four months following the closing date. Proposals received after the January 15, 1961 closing date will be reviewed following the summer closing date of May 15, 1961.

The next closing date for submission of proposals for specialized biological facilities is March 1, 1961. The NSF has two programs for support of facilities, one for general graduate level university laboratories and the other for specialized biological facilities. The latter are defined as discrete research installations which are unique, one-of-a-kind, or at least less than ordinary in that they are not a usual part of a university department.

Inquiries should be addressed to the National Science Foundation, Washington 25, D.C.

The American Institute of Biological Sciences, with support from the National Science Foundation, has embarked upon a program of foreign biological literature translation. The first phase of this program is the translation of Russian biological journals and monographs. Additional information may be obtained by writing to the A.I.B.S., 2000 P Street, N.W., Washington 6, D.C.

ORNITHOLOGICAL LITERATURE

THE WATERFOWL OF THE WORLD. By Jean Delacour. Volume Three. Eiders, Pochards, Perching Ducks, Scoters, Golden-eyes, Mergansers, and Stiff-tailed Ducks. Country Life Limited, London, 1959: 8 × 10 inches, 270 pp., 46 maps and 20 color plates by Peter Scott. 6 guineas.

The third volume of this sumptuous production has now appeared; previous volumes were reviewed in *The Wilson Bulletin*, vol. 67, 1955, pp. 314–317, and vol. 71, 1959, pp. 288–289. Many of Dr. Elder's comments in his review of the first volume apply to the work as a whole, and will not be duplicated here. A three-volume set was originally planned, but supplementary material intended for the third volume proved to be of sufficient amount to warrant publication of a fourth volume. This is to include "some general chapters on the morphology, anatomy and biology of the family; on history, sport, conservation, care and breeding; and also a bibliography. . . . It will also contain additions and corrections that have come to light since the publication of the first two volumes."

Such a volume, supplementing the first three, is badly needed, and it is perhaps unfair to review a single volume of the work without knowing just what will appear in the final part. Emphasis in the present review, therefore, will be on what is included rather than what is omitted from volume three.

As is well known, Delacour's "Waterfowl" is a large and expensive work, reminiscent in its format of the era of lavishly produced illustrated monographs of bird families. The typography is handsome, the binding attractive (in appearance if not in strength), the margins wide, and the colored plates abundant. This emphasis on physical appearance, with its concomitant high price, inevitably leads to conjecture as to the audience for whom the book is intended, and I confess that this question has me puzzled. One might suspect that the aim is toward that group often referred to as "rich sportsmen"; if this is the case, there is much technical matter, taxonomic and otherwise, that would seem superfluous. If aimed at the scientist, there is too much vagueness in the text ("Second year males resemble adults, with brown spots here and there," p. 20). Few scientists (at least in biology) and fewer students can justify a total personal expenditure of well over $60 for a publication of this type, and must hope that the libraries of their respective institutions can fit such a purchase into their budgets.

One of the major drawbacks of the book in its attempt to be all things to all people stems, it seems to me, from a deliberately chosen policy. Delacour states in his introduction (p. 15) ". . . the familiar species have been dealt with briefly as detailed information is readily available in other works. But the less known ones have been treated at greater length and important new information on them given as completely as possible." I firmly believe that this policy was ill-advised, although it undoubtedly enabled the book to be published more quickly. The mass of "detailed information . . . readily available in other works" for the common species is, in a group as popular and important as the waterfowl, so extensive and so widely dispersed that the greatest contribution Delacour could have made would have been a thorough synthesis of this vast literature. As it is, Dr. Elder pointed out in his review of the first volume that Delacour overlooked or ignored numerous important papers dealing with species covered in that volume. Because of this stated policy of the author's, we find in volume three the anomalous situation in which 7½ pages are devoted to the rare Brazilian Merganser (*Mergus octosetaceus*), and less than 4½ pages each to the holarctic Goosander and Red-breasted Merganser (*M. merganser* and *M. serrator*). Of the material on the Bra-

zilian Merganser, no less than 5½ pages are allotted to a direct quotation of the excellent paper by Partridge (1956. *Auk*, 73:473–488), a reference readily available in its entirety to any interested reader. The scientist and the student will turn to the original paper rather than to Delacour's abridgment for information about the Brazilian Merganser, and I suspect that most other potential readers of the book would prefer a relatively greater amount of space devoted to species they are likely to encounter personally.

Dr. Elder has previously commented on the amount of space devoted to accounts of each species in captivity. It is, of course, a truism that any book begins to be out-of-date from the moment of publication, but it seems unnecessary to augment the opportunities for obsolescence through the frequent listing of waterfowl collections in which a species is or is not represented "at present."

Generalizations made in the text sometimes appear to go beyond what is justified on the basis of known facts. In the account of "General Habits" of the pochards, the statement is made that "All species assume their adult plumage and breed in the first year" (p. 44). This could be definitely determined in wild birds only with marked individuals. And if the evidence afforded by captive birds be accepted, it must be noted that, as of the date of Delacour's writing, three species of pochards had never bred in captivity (*Aythya novae-seelandiae* has since bred at Slimbridge—a good example of the ephemerous nature of statements about "present" status in captivity). On p. 171, the casual dismissal of the complicated plumage cycle of the Old-squaw (*Clangula hyemalis*) as "of no real importance" is a value judgment out of place in the writings of a scientist.

Classification follows essentially that proposed by Delacour and Mayr in 1945. The major change is the segregation of the eiders as a separate tribe Somateriini, considered to be an offshoot of the Anatini, following Humphrey (for a dissenting opinion, see Johnsgard, 1960. *Condor*, 62:31). Taxonomic judgments at the subspecific level are quite inconsistent. Delacour admits *Somateria mollissima faeroeensis*, although calling it "a poorly characterized subspecies." On the other hand, *S. m. sedentaria*, which also, to Delacour, "seems to be poorly characterized," is denied recognition (although it is an excellent race, as anyone who has ever examined the pale females and downy young can testify). The supposed western race of Harlequin Duck, *Histrionicus histrionicus pacificus*, is admitted on the strength of its "rather larger bill," although Dickinson (1953. *Bull. Mus. Comp. Zoöl.*, 109:139) showed that less than 50 per cent of a sample including 32 eastern and 35 western specimens could be separated on this or any other basis. Delacour gives no comparative measurements to support his statement about bill size. He does give measurements for most subspecies based on size (there is an apparent misprint in the figures for culmen length of the American Golden-eye on p. 181), but in no case does he indicate the size of the series on which these figures are based, nor whether the measurements are original or compiled.

Details of distribution as presented in the text and on the maps must be evaluated by specialists, but I have found inaccuracies in the treatment of some of the species with which I happen to be familiar. For example, the breeding of the Ring-necked Duck (*Aythya collaris*) in the Adirondack region of New York was first reported by Severinghaus and Benson in 1947 (*Auk*, 64:626–627), and the population there has expanded in subsequent years, but is not shown on the distribution map (p. 75). In fact, a comparison of Delacour's map for this species and that presented by Mendall (1958. *Bull. Univ. Maine*, 60, no. 16: Fig. 3) is quite instructive. The "new colony in Pennsylvania" mentioned by Delacour refers to nestings between 1936 and 1939 in the newly-flooded Pymatuning Lake (several other species of waterfowl bred here for a few years after the lake was created). Mendall (*op. cit.*, p. 298) believed that a few pairs

may have nested at Pymatuning as late as 1954, but Grimm (1952. *Birds of the Pymatuning Region*, Pa. Game Comm., Harrisburg:84) knew of no nesting after 1939.

Various minor errors have been perpetuated from older literature (see also Dr. Elder's review of volume one in this regard). There seems to be no basis for the ascription of a yellow iris to the male King Eider (*Somateria spectabilis*), although it is so described in, among other works, *The Handbook of British Birds* (see Sutton and Parmelee, 1955. *Arctic*, 8:145). The downy young of Steller's Eider (*Polysticta stelleri*) does have light dorsal spots, *contra* Delacour and other authors (Parkes, MS. *Handbook of North American Birds*).

The colored plates are such an important feature of this work that many people are in the habit of referring to it as "Delacour and Scott," although Peter Scott served as illustrator only, not as coauthor. Mr. Scott has avoided monotony in his fine series of portraits by using a variety of background colors, and by varying his style of painting to some extent. As a matter of personal preference, I like the crisper figures and relatively uniform backgrounds of the series of paintings of *Anas* in volume two better than the softer (and seemingly more hastily-painted) figures and "busy" backgrounds of such plates as those of the wood ducks, comb ducks, and stiff-tails of volume three.

At least one error has crept into the plates. The "male in eclipse" of the Carolina Wood Duck (*Aix sponsa*) on plate VII is actually a female; the male retains his distinctive white facial markings when in "eclipse." And among ducks with as complicated a series of plumage changes as the large eiders, in which the aspect of the young males is almost constantly changing during the first two years of life, a figure labeled "immature male" is rather meaningless (plates I and II). When illustrating birds in anything other than a definitive "adult" plumage, more artists should follow the example of Schiøler in his classic "Danmarks Fugle"; in the latter work both the collecting date and presumed age in months of the figured specimen are given in the caption.

In some instances Mr. Scott has apparently been the victim of poor color reproduction. The heads of the female mergansers on plate XVI, for instance, are not nearly red enough (this is, to my eye, one of the least successful plates in the book). The bill of the male King Eider on plate II, on the other hand, appears to be too red (compare Sutton and Parmelee, *op. cit.*, Fig. 1). The browns of plate IV (Canvasback, Redhead, European Pochard) are not accurate.

These criticisms do not alter the fact that we will not have again for many years, if ever, as complete a set of generally excellent portraits of the world's waterfowl, painted by a man who has studied almost all of them in life and most of them in the field. Perhaps it will be possible at some future time to reprint these plates in a more inexpensive format, as was done for such works as Roberts' "Birds of Minnesota" and Forbush's "Birds of Massachusetts," in order to make the illustrations available to every student and admirer of waterfowl.

As mentioned earlier, reviewers of a single volume of an uncompleted work are at something of a disadvantage, particularly in the present instance in which the promised fourth volume is to remedy some of the shortcomings of the first three. Although the text thus far contains much of interest and usefulness, viewed in the light of Captain Delacour's international reputation as an authority on waterfowl it can only be characterized as disappointing.—Kenneth C. Parkes.

Wildlife of Mexico. The Game Birds and Mammals. By A. Starker Leopold. University of California Press, Berkeley and Los Angeles. 1959: 7 × 10½ in., xiii + 568 pp., 194 figs., 1 map in color. 18 tables, 2 color plates. $12.50.

Mexico's diverse geography and climate have led to the formation of a biota that is

unusually rich and varied. In spite of this wealth, or perhaps because of it, there are few countries that show less concern for the conservation of their plant and animal resources or that exploit them with such devastating effectiveness. This is not new. From Díaz del Castillo in the sixteenth century, through Humboldt and Gadow, to the present, people have marveled at the diversity and richness of the Mexican landscape and chronicled and lamented its abuse. Now, however, the burgeoning population and economy of Mexico have accelerated this exploitation and the vast undisturbed areas which once existed are rapidly disappearing. Perhaps even worse than the destruction of virgin country is the denudation of huge tracts of agricultural land through faulty cultivation. Caught between dwindling habitats and increased hunting pressure, the wildlife is decreasing at a critical rate. Mexico must soon implement a sound conservation program or large portions of its flora and fauna will be forever lost.

"Wildlife of Mexico" was written with the intent of arousing popular interest in the fauna and creating concern for its conservation. It is, therefore, a "popular" book, but the biologist will find much of value in this attractive and exceedingly well-written volume.

The book is divided into three parts. The first, "The Wildlife Resource and its Management," contains brilliantly clear descriptions of the physiography of the country, the use to which the land is put, the manner in which the wildlife is utilized, and the present ineffective program for wildlife conservation. A plan for establishing refuges, improving habitats, educating the sportsmen, and implementing similar projects is also presented.

The chapter on "The Mexican Landscape" contains the best generalized account of the vegetation of Mexico to be found anywhere. Excellent photographs and a map in color greatly enhance the effectiveness of this description. Unfortunately, the map depicts only the former extent of the various vegetation types, although the present range is often markedly different. The text usually indicates where such discrepancies occur, but it would seem that a map showing these differences would be particularly valuable.

It is evident from the chapters on the exploitation of the land and its wildlife that Leopold understands and likes the Mexican people. Because he is *simpático* he is not pedantic and exasperated, which one must surely become if one attempts to apply American standards and practices of wildlife conservation to the Mexican scene, without a full appreciation of Mexican customs and viewpoints. Leopold is no head-in-the-clouds conservationist who insists that in order to preserve one must set aside areas where the land is not utilized, and the animal population is allowed to achieve its own level without the manipulations of man. Rather, he recognizes that the wildlife resources of Mexico can be harvested for the benefit and enjoyment of the people. This is an important point in a country where the whole idea of conservation is new and where the "What's in it for me?" attitude generally prevails, whether from mere ignorance or genuine need imposed by poverty.

The second part of the book treats of the game birds. The "game birds" are the types generally considered to be such in the United States. Resident species are thoroughly covered; transient or wintering forms (e.g., ducks) are briefly noted. Small birds, even though they may belong to game bird groups, as the *Columbigallina* and *Claravis* ground doves, are omitted, as are all of the Charadriiformes. Some species within these groups, particularly the ground doves, are of considerable local importance as food. One might quibble about their omission. A line must be drawn somewhere since in certain areas of the country almost any animal, ranging from flycatchers and lizards to caterpillars and grasshoppers, is considered fair "game." I should like to see the ground doves and some

shorebirds covered in the book, but would not insist upon the inclusion of grasshoppers.

The birds are grouped by orders and families. A general discussion of the attributes and distribution of the group precedes the species accounts. Each species is treated separately; exceptions are the four sibling species of *Leptotila* doves and three of Tree Quail.

A full-page black and white drawing illustrates every resident species; the nonresident forms are grouped, with two or more species to a page. These drawings, by Charles Schwartz, are handsome and have considerable vitality. Insets are used often to illustrate features of particular interest, such as the shape of a crest or the differences between the races of a species. Schwartz is a master at conveying an impression of the bird's habitat through simple background details like a corn stalk fragment, a philodendron leaf, or a distant thatched hut. An outline map showing the range of the species in Mexico also is included in each drawing.

The illustrations are supplemented in the text by descriptions of coloration and by measurements, including weights. A paragraph devoted to range includes details relative to habitat, abundance, and migration which are not evident on the outline maps.

A generalized life history account of the species follows. This varies greatly in length and detail according to the species considered. Here is assembled information which, for the most part, has not been available in a single source or which is totally new. The account ranges from estimates of population densities, descriptions of food and habitat requirements, and data on breeding to recommendations for managing species and comments on their culinary qualities. The sportsman will find the account interesting; the biologist will welcome the synthesis of much scattered information.

The third section of the book is devoted to game mammals and follows the same pattern used for the birds. The Grizzly Bear and Ocelot are illustrated in color. These plates are not nearly so effective as Schwartz's black and white drawings.

Appendices on Mexican game laws and regulations, a bibliography, and a good index conclude the volume.

This is a fine book. When it is translated into Spanish, which is said to be imminent (p. 2), it should help toward stirring local interest in Mexico's wildlife, and, we hope, will stimulate a forceful effort to preserve it. There is little likelihood, unfortunately, that such an elaborate and comparatively expensive book will have a wide circulation in Mexico, but possibly it will reach and influence the more affluent Mexicans who, perhaps, are in the best position to initiate serious conservation efforts. If this fails, "Wildlife of Mexico" will at least stand as an opulent obituary.—Raymond A. Paynter, Jr.

Check-list of Birds of the World. A continuation of the work of James L. Peters. Volume IX. Edited by Ernst Mayr and James C. Greenway, Jr. Museum of Comparative Zoology, Cambridge, Mass., 1960: $6\frac{1}{2} \times 9\frac{1}{4}$ in., xii + 506 pp. $6.00.

The primary purpose of the average review is to help the reader to decide whether he wishes to buy, or have his institution buy, the book being reviewed. The reviewer likes to believe that an enthusiastic notice will help to stimulate sales, and that a real "roasting" will keep his readers from wasting their money. This approach cannot be used, however, for a volume of a standard reference work such as the Peters "Check-list." Such a book may be virtually indispensable to many readers, without any relation to possible defects or inadequacies. One simply *must* have the volume for one's professional library. The reviewer, therefore, addresses his words as much to the authors and editors of the reference work as to the reader, in the hope that constructive suggestions and corrections may be adopted in later volumes.

Few reference works are more important to the working ornithologist than the check-list commenced by the late James L. Peters in 1931, and completed through Volume 7 (of a projected 15) at the time of his death in 1952. The project is being continued by an international group of taxonomists under the direction of Ernst Mayr and J. C. Greenway, Jr., of the Museum of Comparative Zoology at Harvard. The relative difficulty of certain of the remaining families of passerine birds and the limitations of time available to the various authors of this project have necessitated a publication schedule which does not coincide with the numerical sequence. As mentioned above, Volume 7 was the last completed by Peters himself; the present volume is no. 9, and the next to appear will probably be no. 15.

A few changes in format characterize Volume 9, which includes the first 13 families of oscines. A useful binomial heading has been added for every species as a guide to the eye; this is a distinct improvement. Synonymies are limited to names not cited by Hellmayr (New World) or by Hartert or Sharpe (Old World). Descriptions of ranges, particularly of winter ranges of migratory forms, have been given somewhat fuller treatment than was done by Peters. The volume itself was printed in Denmark, presumably to save on costs. For a work set up in type by printers whose native tongue is not English, it is gratifyingly free of typographical errors, but among those few that were not caught are some in words that are not English (cf. "Linneaus" twice on p. 115; "**Troglodytns**" on p. 423).

The sequence of families is that outlined previously by Mayr and Greenway (1956. Breviora, no. 58:1–11). This sequence has been the source of no little controversy, and I will confine myself to stating that I ally myself completely with the viewpoint expressed by Storer (1959. *Condor*, 61:152–153). That the 1956 classification is not, after all, sacrosanct is indicated by two reversals of decision at the family level; the Palm-chat, *Dulus*, is given full family rank rather than being placed as a subfamily of the Bombycillidae, and the Prionopidae of 1956 (which included the strange Bornean *Pityriasis*) are reduced to a subfamily of the Laniidae, with *Pityriasis* given a subfamily of its own at the opposite end of the family from the Prionopinae.

The editors admit, in an introduction, that the multiple authorship of this and future volumes results in an unevenness of taxonomic viewpoint (well illustrated by the contrast in treatment between the adjacent families Troglodytidae and Mimidae in this volume). They point out, quite rightly, that Peters himself had shifted toward broader generic and specific concepts in the course of his seven volumes, and it is obviously impossible to state that Peters would or would not have approved of certain "lumpings" in this volume. A certain degree of continuing conservatism on Peters' part is manifested, for example, among the swallows, the manuscript for which he had completed before his death; the Barn and Cliff Swallow assemblage is divided into three genera rather than combined into one as advocated (I believe rightly) by Mayr and Bond (1943. *Ibis*: 334–341).

I find that most of the criticisms of this volume that I have jotted down while going through it prove to be concerned with matters of editorial policy, and are matters that, should the editors find my criticisms constructive, can be changed in forthcoming volumes. Perhaps the most serious fault of the present volume has to do with the establishment of author (or editor) responsibility for a given statement.. The names of the authors responsible for the various families are given only at the beginning of that family in the text; adding this information to the table of contents would save much thumbing back and forth. To indicate to the reader of this review just which families are included in Volume 9, and who the authors are, a summary follows: J. L. Peters (Alaudidae, Hirundinidae, Campephagidae [part]); C. Vaurie (Palearctic Motacillidae

and Troglodytidae); C. M. N. White (African Motacillidae); E. Mayr (Southeast Asian Motacillidae, Campephagidae [part]); J. C. Greenway, Jr. (American Motacillidae, Bombycillidae, Dulidae, Cinclidae); H. G. Deignan (Campephagidae [part], Oriental Pycnonotidae); A. L. Rand (African Pycnonotidae, Laniidae, Vangidae); J. Delacour (Irenidae); R. A. Paynter, Jr. (American Troglodytidae); J. Davis and A. H. Miller (co-authors of Mimidae with no division of responsibility indicated).

For those families originally prepared by Peters, there is no indication as to who brought the manuscripts up to date after his death in 1952 (numerous later papers are cited), although, as for all other families, there are footnotes stating by whom the manuscript for that family was "read." In the family Campephagidae, Peters and Mayr are each listed as being responsible for part of *Coracina*. A new name in this genus, *C. tenuirostris numforana*, is introduced on p. 187 with no indication as to its proper authorship.

An addendum on the last page of the text picks up a species and a subspecies inadvertently omitted from their proper places, and introduces another new name to replace one found to be preoccupied. This name, *Pycnonotus barbatus zeilae*, is not credited to any author. As it refers to an African bulbul, one would assume the author to be A. L. Rand, but I am informed that Dr. Rand saw this name for the first time when the book was published. The authorship of this name should be clarified in print as soon as possible. Unlike previous volumes of the Peters check-list, there is no list of newly proposed names. In addition to the two new names mentioned above, I found, by diligent page-thumbing, *Pycnonotus cafer wetmorei* Deignan (p. 236) and *Hypsipetes amaurotis nagamichii* Deignan (p. 295). I may have missed others.

In view of this rather careless handling of nomenclatorial matters, it comes as something of a shock to find the footnote initialled by Mayr (p. 193), rejecting a substitute name proposed by Ripley (1952. *Condor*, 54:362), giving as justification a highly dubious nomenclatorial technicality. This is not the place to go into details, but I can say that if Mayr believed Ripley's name to be invalid, he should have proposed a substitute. As it now stands, the name *panayensis* is used for two different forms of the genus *Coracina* in what is supposed to be the definitive check-list of birds of the world.

The footnote mentioned above is almost the only one in the book to which initials have been appended, and it was presumably done in this case because Mayr and Peters were each responsible for part of the genus *Coracina* (but see above with respect to the authorship of *C. tenuirostris numforana*). One would assume that all other footnotes were to be credited to the author of the family involved. However, the unsigned footnote on p. 131 was not written by Vaurie, the author of the section in which it appears; in fact, the opinion expressed in the footnote is directly contrary to that held by Vaurie (pers. comm.).

The introduction specifically states that "no new material has been added after July 1, 1958." I heartily commend the publication of such closing dates (absent in all too many check-lists, including that of the A.O.U.), but strongly urge that they be faithfully observed once set. In Volume 9, I note the inclusion of *Hypsipetes everetti samarensis* Rand and Rabor (p. 288), published in the *Auk* for January, 1959. Rand also cites Vaurie's "Birds of the Palearctic Fauna" (1959) in his list of references for the family Laniidae, although no other author (including Vaurie himself) does so. It may be argued that such last-minute inclusions add to the completeness of the volume. On the other hand, they are unfair to other authors who may have published new forms or revisionary studies between the announced deadline and the publication date, and whose works have *not* been taken into account.

One of the major departures in style from earlier volumes in the Peters series is the

introduction of English vernacular names, which are alleged to have been adopted "where a species occurs in English speaking countries and has a well known vernacular name." The application of this principle, as the editors admit, has been inconsistent. Examination of the names applied to members of a large genus such as *Pycnonotus* reveals many such inconsistencies. For example, *P. urostictus*, which is given an English name, is a species confined to the Philippines, a country in which English is more widely used than the "national language" of Tagalog. But *P. goiavier*, probably the most common species of bulbul in the Philippines (and widely distributed elsewhere in southeast Asia), is given no English name. Since this check-list is written in the English language, I believe that the proper step would have been to apply English names to all species or to none. Standard reference books in English are available for virtually all parts of the world's avifauna, and attempts are now being made to standardize English names of birds from primarily non-English-speaking countries (cf. Eisenmann, "The species of Middle American birds." 1955. *Trans. Linn. Soc. N.Y.*, 7: 128 pp.). Selection of appropriate English names for all species in the Peters list would do much to help such stabilization.

As in my review of Vaurie's check-list of Palearctic birds (1959. *Wilson Bull.*, 71: 286–288), I do not propose to dwell at any length on my own reaction as a taxonomist to the handling by various authors of groups I have studied. Differences of taxonomic opinion, I repeat, are inevitable, and need not be listed or mentioned unless an author is an outrageous extremist, certainly not the case here.

I may say in passing that I had felt for some time, on a purely empirical basis, that the family "Irenidae" as constituted in the present volume was an artificial one. It was therefore of great interest to me to see Wetmore's recent and highly plausible suggestion (1960. *Smithsonian Misc. Coll.*, 139, no. 11:19) that *Irena* should be placed in the Oriolidae, leaving *Aegithina* and *Chloropsis* as the family Chloropseidae.

Again as done in my review of Vaurie's check-list, I propose to indicate here, for the benefit of interested readers of the *Wilson Bulletin*, the differences (other than mere differences of sequence) in taxonomic treatments of the A.O.U. Check-list and the new Peters volume. These are as follows:

1. *Iridoprocne* is included within *Tachycineta* (see Brodkorb, 1957. *Jour. Paleontology*, 31:130–131).
2. *Progne cryptoleuca* is considered conspecific with *P. dominicensis* (see also Eisenmann, 1959. *Auk*, 76:532).
3. *Petrochelidon pyrrhonota hypopolia* is considered inseparable from *P. p. pyrrhonota*, and *P. p. minima* doubtfully distinct from *P. p. melanogaster* of Mexico.
4. *Petrochelidon fulva cavicola* of Cuba (accidental in Florida) is considered inseparable from *P. f. fulva* of Hispaniola.
5. *Anthus pratensis* (accidental), treated as monotypic by A.O.U., has an additional subspecies in Ireland (*theresae*).
6. *Lanius ludovicianus miamensis* Bishop is admitted (see Rand, 1957. *Auk*, 74: 503–505).
7. The specific name of the Bohemian Waxwing is *garrulus*, not *garrula* (see Parkes, 1958. *Auk*, 75:479).
8. The Ptilogonatidae are placed as a subfamily of the Bombycillidae, with a footnote stating that this relationship has not been proved.
9. The specific name of the Cactus Wren is *brunneicapillus*, not *brunneicapillum* (see Mayr, 1958. *Auk*, 75:225).
10. *Catherpes* is included within *Salpinctes*.
11. *Telmatodytes* is included within *Cistothorus*.
12. *Cistothorus palustris dissaëptus* is considered inseparable from *C. p. palustris* (but

see Parkes, 1959. *Ann. Carnegie Mus.*, 35:275–281), and *C. p. iliacus* and *C. p. laingi* revert to the "Prairie" and "Alberta" Marsh Wrens respectively.

13. *Troglodytes troglodytes tanagensis, seguamensis, stevensoni,* and *petrophilus* are all considered inseparable from *T. t. kiskensis.*
14. *Troglodytes aëdon baldwini* is considered inseparable from *T. a. aëdon, T. brunneicollis* is considered conspecific with *T. aëdon,* and *T. a. vorhiesi* is considered inseparable from *T. a. cahooni* of Mexico.
15. *Toxostoma bendirei* is considered polytypic, with two additional races in Mexico. —Kenneth C. Parkes.

Life Histories of Central American Birds. II. Families Vireonidae, Sylviidae, Turdidae, Troglodytidae, Paridae, Corvidae, Hirundinidae, and Tyrannidae. By Alexander F. Skutch. Illustrated by Don R. Eckelberry. Cooper Ornithological Society, Pacific Coast Avifauna No. 34, 1960: 7 × 10½ in., 593 pp., 100 figs., 1 col. pl. $15.00 ($14.00 in paper covers).

This volume of life history studies of tropical birds is the second major contribution to a series of assembled reports of critical studies made by Alexander Skutch. Having already covered five families from the Fringillidae through the Coerebidae in Part I, Skutch here presents work involving eight families from the Vireonidae through the Tyrannidae. This volume is considerably larger than the first, and includes studies of 59 species, as follows: Vireonidae, 3; Sylviidae, 2; Turdidae, 5; Troglodytidae, 12; Paridae, 1; Corvidae, 2; Hirundinidae, 3; Tyrannidae, 31. This work does not pretend to provide a complete coverage of all Central American birds, but a good sampling of representative species, for many of which detailed information has been almost completely lacking heretofore.

The treatment of each successive species follows the same general pattern which was established in Part I. It opens with a description of the bird's plumage and general appearance, its distribution, and something of its habits, including food habits, in an introductory section. Next come separate sections on voice, nest building, eggs, incubation, the nestlings, and finally a summary. Where more information is available for a species there may be additional titled categories, and where there is only a small amount of material it may be presented with fewer subheadings or none. Five of the reports are short résumés of longer papers which Skutch has previously published elsewhere. Original reports of as little as three pages in length have been included here, along with others extending to more than 15 or 20 pages. This is commendable because so many species are poorly known, the material might not otherwise be available for many years, and even an incomplete life history contributes greatly to a more nearly complete understanding of the Central American avifauna.

Most of the observations upon which this book was based were made in Guatemala, Honduras, Costa Rica, or Panama, during the period from 1929 to 1956.

Adding to the attractiveness and usefulness of the book are the numerous photographs, and the black-and-white halftones of birds, and the color frontispiece of three small flycatchers. With the exception of the three flycatchers depicted in color, each species in the book is represented by a drawing within the pages devoted to that species account. As far as I can determine, no separate credits are given for the photographs, so I assume that they are the contributions of the author. The bird drawings, obviously the work of an accomplished artist well acquainted with the species involved, were done by Don R. Eckelberry.

The section on flycatchers particularly, comprising 291 pages, is certain to intrigue

as well as inform the reader as he follows Skutch's progression from the species which build open, bowl-shaped nests to those which build completely enclosed, hanging nests; from species in which the male participates to a considerable extent in nesting activities, to those in which it takes no interest in the nest. Most readers will marvel at the extent and accuracy of the information on roosting, time of egg laying, incubation periods, nestling periods, family activities, and characteristic mannerisms, in species after species, some bold and colorful, others extremely plain and retiring.

The uniformity of approach, methods, organization, and interpretation evident in these studies is one of the major virtues of the series. The preparation of a summary for each species, except in the five reports which are summaries in themselves, further consolidates and unifies the presentation. Although there are nearly 200 titles in the list of Literature Cited, this work is not intended as a compilation of all known life-history data for each species. Therefore, some students may know a few details which are not included here, and certainly many additional facts will be learned in the future. For example, we could supplement Skutch's findings by mentioning that *Turdus assimilis* frequently occurs at 8,000 to 10,000 feet elevation in Mexico; that *Catharus aurantiirostris* may be found in parts of Mexico at 7,000 to 8,000 feet elevation; that *Legatus leucophaius* regularly uses the nest of *Icterus gularis* in Mexico. Eventually a compiler will add such fringe information to the detailed basic material which Skutch provides. However, the excellence and thoroughness of the presentation here is such that further developments will be more in the nature of broadening the picture of each species rather than bringing it into sharper focus. Skutch has such a wealth of information that it is most appropriate that here he should restrict himself largely to presenting the results of his own observations, rather than attempting a complete compilation for each species. He has acted as a compiler to the extent of presenting a summary of available information on the natural history of each of the eight families, in a separate section of five or more pages, at the end of the group of species accounts for that particular family.

Because of the writer's knack for presenting facts in an interesting manner, because of the inherent interest which life history material holds for many readers, because of the fact that most of the species treated are intriguing or unusual in many ways, and because the American tropics seem to have a glamorous fascination for many North Americans, this book should have wide popular appeal in addition to its great scientific value.—Ernest P. Edwards.

Winter Foods of the Bobwhite in Southern Illinois. By Edward J. Larimer. Illinois Natural History Survey Division Biological Notes No. 42, May, 1960: 8½ × 11 in., paper covers, 35 pp., illustrated.

This paper adds 34 counties in southern Illinois to the long list of geographic areas for which the food habits of the Bobwhite have been analyzed. The findings are based on data from crops of 4606 Bobwhites taken by hunters in two 31-day periods (November 11 to December 11) in 1950 and 1951. Larimer found, as have others, that Bobwhites subsist primarily on vegetal materials of cultivated origin in the early winter.—Thane S. Robinson.

Hawks and Owls: population trends from Illinois Christmas counts. By Richard R. Graber and Jack S. Golden. Illinois Natural History Survey Division Biological Notes No. 41, March, 1960: 8½ × 11 in., paper covers, 24 pp., illustrated.

Christmas bird censuses in the state of Illinois in the 52-year period, 1903–1955, have yielded data on 28 species of hawks and owls. For those who feel that such censuses are significant from the quantitative standpoint, this paper will be of interest. The

information extracted by Graber and Golden indicates that there has been a marked decline in the raptor population of Illinois since 1903, with the Rough-legged Hawk being most severely affected. Only a few species seemingly are on the increase. These include raptors that have been placed on the protected list, such as the Sparrow Hawk, Bald Eagle, and Marsh Hawk. The authors conclude that humans have been instrumental in regulating the seeming population trends of Illinois hawks and owls.

William E. Clark, photographer with the Illinois Natural History Survey, is to be commended for the excellent photographs of nine species of raptors that are reproduced, in black and white, in this publication.—THANE S. ROBINSON.

A TREASURY OF NEW ZEALAND BIRD SONG: AN ALBUM OF THREE RECORDS OF THE SONGS OF NEW ZEALAND BIRDS IN THE FORESTS, MOUNTAINS AND COUNTRYSIDE. By Kenneth and Jean Bigwood. Accompanied by a booklet, THIRTY NEW ZEALAND BIRDS, by Gordon R. Williams. A. H. & A. W. Reed, 182 Wakefield Street, Wellington, 1959: 7 × 7 in., 40 pp., photos. Paper covered. Album and booklet, boxed, about $6.30; records available separately at $2.00 each.

A fine addition to the slowly growing list of "natural sound" recordings! On the "extended play" (45 r.p.m.) records are preserved the voices of six native songbirds, 12 introduced songbirds (including the Australian Bell-magpie), some parrots, the Kiwi and other flightless species, some water birds, etc. The quality is excellent, as can be seen by comparing the English species, e.g., Blackbird and Skylark, with other available reproductions. The spoken commentary is graceful; yet anyone trying to study the songs soon finds the reiteration of the already memorized sentences an annoying distraction. Would it not be better to have no commentary and more songs? The booklet describing the species is pleasantly and ably written. It presents briefly the history of the New Zealand avifauna, and does what can reasonably be done (or a trifle more?) to gloss over the destructiveness of man, and to bring out the partially compensating enrichments of the fauna and flora due to him. There is an admirable essay on "Bird songs and calls." It contains a curious mistake. Perhaps in Australasia it is *almost* the case that the "songbirds, or Oscines" are "the only ones that have true song." Yet the 8600-odd species of the world's birds had just been mentioned, and however one defines "true," hundreds of non-Oscines truly sing. If the criterion is territory advertisement, then non-Oscine examples may well exceed 1000; and if one requires also recognizable musical character, they are still numerous. Thus the 15-second ascending chant of the Antbird (*Chamaeza ruficauda*) in Brazil; or the famous twilight song of the Wood Pewee (*Contopus virens*). There is a delightful specimen of musical rhythm in a hummingbird of Jamaica, *Mellisuga minima*, also in the non-parasitic cuckoo of North America, *Coccyzus erythropthalmus*.

Presumably certain New Zealand species, such as the Wattle Crow (*Callaeas cinerea*), were not recorded because they could not be found (extinct?). But why omit the White-eye (*Zosterops lateralis*)?

Of the native songsters, outstanding are the Tui (*Prosthemadera novaeseelandiae*), the Bellbird (*Anthornis melanura*), the Grey Warbler (*Gerygone igata*), and the Robin (*Petroica australis*), a flycatcher. The first two of these are certainly among the most fascinating of all avian musicians. The writer admits himself mightily puzzled: he did positively identify and make careful notes on singing Tuis and Bellbirds during a short stay in the islands, and the songs they sang had only a remote resemblance to those on this record. Apparently the differences of local dialect, or the individual and seasonal variations, to which Williams refers, go far indeed. I wonder if Captain Cook's quoted testimony to the Bellbird's music was not really a response to a mixed and, to

him, indistinguishable chorus of both species, which often sing from neighboring trees, and as this record shows, rather similarly (though I *thought* I observed wide and clear differences at Rotorua and Waikaramoana).

We should be most grateful to the three producers of this valuable set.—CHARLES HARTSHORNE.

VII BULLETIN OF THE INTERNATIONAL COMMITTEE FOR BIRD PRESERVATION. Published by the I.C.B.P., 1958: 250 pp., 16 pls. Mostly in English, but parts in German, French, and Spanish. Paper bound, $2.10. (Order from G. W. Merck, Secretary, I.C.B.P., New York Zoological Society, 30 East 40th Street, New York 16, N.Y.)

An introduction by President Jean Delacour is followed by a declaration of principles, all in four languages. Results of the Fifth and Sixth Conferences of the European Section, held in Italy in 1952 and Holland in 1956, and the Ninth and Tenth Conferences of the I.C.B.P., held in Switzerland in 1954 and Southern Rhodesia in 1957, follow. The discussions include:

(1) Protection of migrating birds and establishment of refuges on migration routes. Refuges established in Belgium, France, Great Britain, Hungary, and The Netherlands and the species benefited are given.

(2) Birds which are a menace to other species. The Herring Gull (*Larus argentatus*), Black-headed Gull (*Larus ridibundus*), and Black-backed Gull (*Larus marinus*), are considered, and the results of many censuses taken in Europe are given with appraisals of the damages and benefits which the species effect.

(3) Oil pollution in the seas. This problem and actions taken in different countries are discussed. Many countries have now ratified the resolutions set up by the I.C.B.P.

(4) Preservation of wildfowl, including much discussion on species with diminishing numbers.

(5) Effect of trade in plumage, cage birds, and carcasses on bird populations. Egret feathers still come to Europe from Venezuela, Gray Jungle Fowl from India, and Birds of Paradise plumes through New Guinea.

(6) Need of protection of birds of prey. Much of the report centers on Holland and the damages and benefits which species there are responsible for. Little mention is given about recent laws enacted in many states in the United States.

(7) Birds threatened with extinction. Thirteen species are listed as being in grave danger. Some, such as the Hawaiian Goose (*Nesochen sandvicensis*) and the Whooping Crane (*Grus americana*), are being helped, but little can be done for others such as the Eskimo Curlew (*Numenius borealis*) or the Cuban Ivory-billed Woodpecker (*Campephilus principalis bairdii*). There is a good summary of the location of the latter in Cuba with numbers observed. The status of the Japanese Crane (*Grus japonensis*) is likewise given.

(8) The effects of pesticides, insecticides, etc. on wildlife. The dangers and effects are discussed by different writers. In many cases protection to man and domestic animals has been enforced, but lack of protection to wildlife has resulted in much damage to birds, mammals, fish, and other forms.

(9) Bird protection. Reports from 17 countries are given.

This is a really worth-while publication. The reader will get much out of it and at the same time help support the I.C.B.P. by purchasing it. Bird protection is an international problem. A refuge created for one species usually benefits many biological forms. With the worldwide explosion of human population, we must consider now many of these serious problems lest we lose not only a few forms, but thousands.—LAWRENCE H. WALKINSHAW.

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This index includes, in addition to names of genera, species, and authors, references to the following topics: anatomy, behavior, distribution, food habits, fossils, measurements, migration, molts and plumages, nesting, parasitism, physiology, populations, predation, taxonomy, voice, and weights. Also included are references of biological significance to mammals, reptiles, and amphibians.

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3rd	1915	Columbus, Ohio	25th	1939	Louisville, Kentucky
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5th	1917	Pittsburgh, Pennsylvania	27th	1941	Urbana, Illinois
6th	1919	St. Louis, Missouri	28th	1946	Omaha, Nebraska
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17th	1930	Cleveland, Ohio	39th	1958	Wheeling, West Virginia
18th	1931	New Orleans, Louisiana	40th	1959	Rockland, Maine
19th	1932	Columbus, Ohio	41st	1960	Gatlinburg, Tennessee
20th	1934	Pittsburgh, Pennsylvania	42nd	1961	Huntsville, Ontario, Canada
21st	1935	St. Louis, Missouri	43rd	1962	Lafayette, Indiana
22nd	1936	Chicago, Illinois			